

APPENDIX A

Electric Load Flow and Design Configuration Analysis Southeast Alaska Intertie Project Kake – Petersburg Intertie

**Prepared by
Commonwealth Associates, Inc.**

**SOUTHEAST ALASKA INTERTIE PROJECT
Kake to Petersburg Intertie**

Electric Load Flow and Design Configuration

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BACKGROUND

The concept of interconnecting the communities of southeast Alaska with an electrical grid has been considered for decades. In 1997, under the leadership of the Southeast Conference, a committee was formed with representation from communities and utilities throughout southeast Alaska. A study by Acres International provided recommendations for implementing a reliable Intertie system in five phases. The Southeast Conference and its members, working closely with the Alaskan Congressional delegation in Washington, D.C., secured passage in 2000 of a bill authorizing the intertie project that included Federal expenditures and a 20 percent local match requirement.

Since 2000 the first two segments of the Intertie project have achieved significant levels of progress. The Swan Lake to Lake Tyee Intertie segment has been designed, permits have been secured, and the project is moving into the construction phase. The first phase of the Juneau to Hoonah Intertie segment, the construction of an overhead transmission line from Juneau to North Douglas Island, is well under way. Design is nearly complete, permitting activities are underway, and construction of the overhead transmission line on Admiralty Island was scheduled for late last summer.

The Kake to Petersburg line is an integral component of the Southeast Alaska Intertie Project and in the full plan will eventually be extended to Sitka and north towards Juneau. Previous studies have identified possible routes for the interconnection between Kake and Petersburg. A potential mining project on Woewodski Island south of Petersburg may add a significant electrical load to the region. This mine was operational around the turn of the century and is a significant potential source of gold and other precious metals.

The Kake electrical system is primarily operated as a 12.47 kV system with most of its load being connected single phase at 7.2 kV. The Kake electric system is powered by one of three 800 kW, 4160 volt, oil-fired diesel generators. Presently only one unit is operated at any one time, but operation is cycled so that each of the units is equally exercised during the year. When the Kake freezer plant was in operation the peak Kake load reached 1000 kW, but since the freezer plant ceased operations the peak summer load has been about 600 kW. Because of the high cost of oil and the additional cost of ferrying oil to Kake, residents are presently paying about 47 cents per kWhr for electrical energy. It is hoped that by interconnecting the Kake community with Petersburg and hence to the Four Dam Pool Project, the cost of electrical energy can be dramatically reduced so that the Kake community can once again experience healthy growth.

The Lake Tyee hydroelectric project, owned by the Four Dam Pool Power Agency (FDPPA), provides electricity to the communities of Wrangell and Petersburg via a 138 kV transmission line presently being operated at 69 kV. Lake Tyee is not operating at capacity and has surplus energy available to support this proposed system expansion. When the Kake to Petersburg line is completed, surplus from Tyee will be available to supply energy to the Inside Passage Electric Cooperative (IPEC) in Kake, thereby offsetting expensive diesel generation being used for that community. Additionally, Lake Tyee energy could permit the potential Woewodski Island mine project to initiate operations and significantly improve the economics of the region. A separate

planned use for the available power from the FDPPA is the Swan Lake to Lake Tyee transmission line, currently under construction by the FDPPA.

The Kwaan Electric Transmission Intertie Cooperative, Inc., is a recently formed legal entity that will serve as owner/operator of specific Intertie segments within the Southeast Alaska Intertie Project, including the Juneau to Hoonah segment and potentially the Kake to Petersburg segment.

SCOPE OF WORK - ELECTRIC LOAD FLOW AND DESIGN CONFIGURATION

1. Develop computer models of the interconnected electric systems to identify preferred system configuration, recommended system enhancements, and special provisions for reliable and economic system operation. A system modeling database shall include available generation resources, existing transmission facilities, and each proposed alternative transmission route's electrical characteristics. Discuss system operational performance characteristics of existing interconnected generation equipment to the new projected transmission system and the new connected electrical loads.
2. Update preliminary specifications of interconnection requirements and modifications.
3. Update preliminary cost estimates to incorporate findings and recommendations of this task.
4. Provide line loss estimates for the primary route and compare with the losses for the alternate routes. Perform load flow analysis for maximum line loading conditions for each alternative in order to select the operating voltage level for the new transmission line for normal expected load growth and projected mining loads.

DESCRIPTION OF CONCEPTS FOR PROJECT DEVELOPMENT

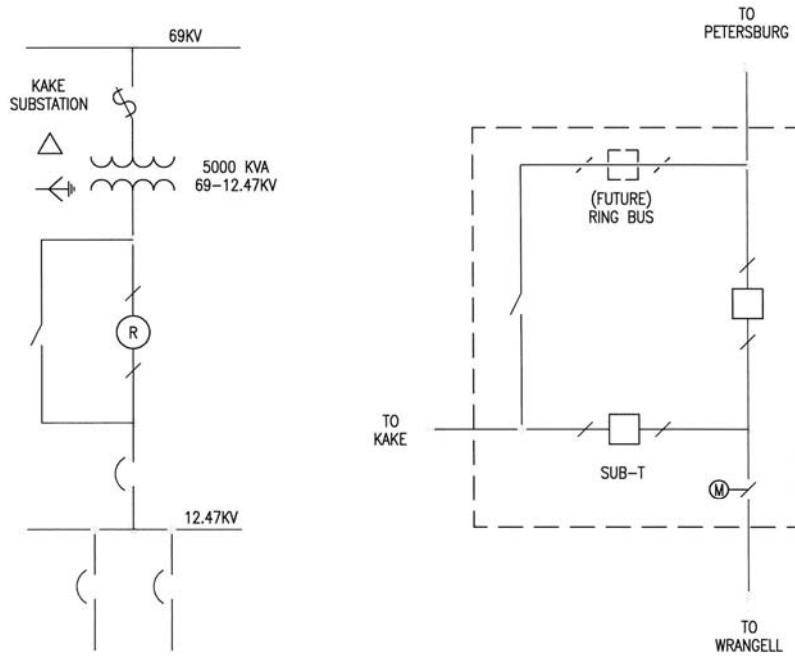
Substation Concepts

In the selection of alternative routes, CAI identified six routes as shown on the Route Alternatives Map in Appendix B. For all of the routes described below that start from "Center," we propose to construct a new switching station at node T that will tap into the existing Wrangell – Petersburg 138/69 kV Intertie. For this report we have designated that substation Sub-T. At Kake, we propose to construct a 12.47 kV distribution substation named Kake Substation. We recommend that these new facilities be configured as shown in the following sketch.

To ensure continued system reliability for the existing Petersburg electrical system, we recommend a breaker for the Kake exit at Sub-T. Circuit problems on the new Kake – Petersburg Intertie will then only affect the Kake load. Similarly, a second breaker is proposed for the Petersburg exit at Sub-T such that circuit problems north towards Petersburg will be isolated from affecting the Kake load. For initial Sub-T exit to Wrangell we recommend a motor-operated disconnect switch. Initially, without special foreknowledge, the unplanned loss of the interconnection to Wrangell will cause an outage for both Petersburg and Kake with or

without a third breaker at Sub-T. Therefore, it is not prudent to add the expense of a third breaker at this time. However, if the Sitka – Kake Intertie is built later, Sub-T should be expanded into a three-breaker ring bus. With two independent sources of supply one will suffice if the other is lost so the added reliability of a full ring bus at Sub-T becomes prudent. Designing the new Sub-T for future expansion into a three breaker ring bus is a nearly zero cost plan to minimize the future costs for when or if the Sitka – Kake Intertie or another similar development is built.

Kake Substation is configured as a single distribution transformer with a primary fused disconnect, distribution class plus or minus 10 percent voltage regulator, and two 12.47 kV exits.



Route Selection for the Transmission Intertie

The six routes identified for this project are described below.

- Center – South Alternative Route (preferred route)**

The preferred route is the Center – South route, which starts at Sub-T (node T) and proceeds via nodes T4, T6, and T7 and hence on to the Kake Substation at node K. This route includes a 2900-foot crossing under the Wrangell Narrows and a second 5700-foot submarine crossing under the Duncan Canal. Compared to the two routes described below, this route includes about three times the submarine cable as the Center – North route and less than a third of the submarine cable required for the Center – Center route. The total length of this route is essentially the same as the shortest route, Center – Center.

2. *Center – Center Alternative Route*

The Center – Center route starts at Sub-T and proceeds via nodes T10 and T9 and hence on to the Kake Substation at node K. In addition to the 2900-foot crossing under the Wrangell Narrows, this route also includes a 26,100-foot submarine crossing under the Duncan Canal. This alternative requires the most submarine cable by a factor of three times that required for the preferred route, but is the shortest in total length of the routes going to Kake.

3. *Center – North Alternative Route*

The Center – North route starts at Sub-T and proceeds via nodes T10, T5, and S3, and hence on to the Kake Substation at node K. This route includes only one submarine crossing of 2900 feet under the Wrangell Narrows just west of node T. This alternative offers the shortest submarine footage but is slightly longer in total length (by about 25 percent) than the previous two alternatives. The greatest disadvantage of this route is that it passes through protected forest lands north of Petersburg and it is expected that obtaining right-of-way would be difficult.

4. *Center – Woewodski (Tap to the potential Woewodski Mine site)*

The Center – Woewodski Tap route is a tap connected to any of the previous three routes starting from node T3, proceeding via nodes T12 and T13, and hence on to Sub-X at node X on Woewodski Island at the proposed new mining site. Alternatively, this could be a separate route, excluding a Kake Interconnection at this time. In that circumstance this route would start at Sub-T and proceed via nodes T3, T12, and T13, and hence on to Sub-X at node X. As a separate route, this alternative includes the 2900-foot crossing under the Wrangell Narrows and an additional 4600-foot submarine crossing, again under the Wrangell Narrows to Woewodski Island. This concept is a separate issue in the Kake – Petersburg Intertie Project.

The next two routes are not expected to be selected for this project and therefore were not analyzed in detail for this report.

5. *South – Woewodski Alternative Route*

The South – Woewodski route would start at a new substation, Sub-W, at node W and proceeded via nodes W2 and W3 to node X on Woewodski Island. From node X the route continues via nodes W5 and W6 and hence on to the Kake Substation at node K. Sub-W would have been configured similarly to the proposed Sub-T. The inclusion of Sub-X at the potential new mine on Woewodski Island could easily be incorporated into this route. This alternative would require a 1400-foot crossing under the Wrangell Narrows between nodes W2 and W3 to Woewodski Island and a second 6500-foot submarine crossing under the Duncan Canal to Kupreanof Island.

6. *Northern Alternative Route*

The Northern route would start at the existing Petersburg Substation at node S and proceed north via nodes S1, S2, and S3 and hence on to the Kake Substation at node K. We propose to construct a new three-breaker switching station at node T that will tap into the existing Wrangell – Petersburg 138/69 kV Intertie. We recommend that this new substation be configured as described for Sub-T. The Northern route requires one 16,600-foot crossing under Frederick Sound near the northern mouth of the Wrangell Narrows.

TRANSMISSION INTERTIE SYSTEM VOLTAGE CONCEPTS

For interconnecting the Petersburg electric system with Kake and/or the Woewodski Mine Site, we examined three possible Intertie system voltage levels: 24.9, 69, and 138 kV, as well as a fourth blend of 138 kV/69 kV.

24.9 kV Intertie Concept

A 24.9 kV intertie is suitable for the light loading levels presently experienced by the Kake community. Two transformers are required, one connecting to the Petersburg electric system and the other at the new Kake Substation. The cost of submarine cables is lower for 24.9 kV than for the 69 or 138 kV concepts. We also found a need in this concept for a 24.9 kV voltage regulator and possibly a 1200 kvar load-side capacitor bank at the new Kake Substation. The disadvantage of this concept is that while suitable for present load levels, the voltage drop at 24.9 kV places low limits on the level of power that can be delivered to the Kake community under this concept in the future. The losses at 24.9 kV are roughly eight times what would be experienced using the 69 kV concept.

69 kV Intertie Concept

A 69 kV intertie is attractive because the planned interconnection point in the Petersburg electric system is presently operating at 69 kV. Thus, only one 69-12.47 kV transformer located at the new Kake Substation would be required for this concept. In order to maximize the future supply capability to Kake, we also found a need for Load Tap Changer (LTC) controls on the new Kake transformer and possibly a future 2400 kVAR load-side capacitor bank, also at Kake. Compared to the 24.9 kV concept, the voltage drop experienced at 69 kV greatly improves the limits on the level of power that can be delivered to Kake. The losses are roughly an eighth of what would be experienced at 24.9 kV. A modest disadvantage is that the cost of 69 kV submarine cable is roughly 20 to 30 percent higher than for 24.9 kV cable.

138 kV Intertie Concept

A 138 kV intertie is attractive because it permits the greatest delivery of power to the Kake community, though far in excess of anticipated needs. Losses are significantly reduced to about one-quarter of the losses expected at 69 kV. The most important advantage is that a 138 kV Intertie is more in keeping with the future operation of the Southeast Alaska Intertie Project. The

existing Tyee – Petersburg Intertie is constructed for 138 kV operation, though it is presently operated at 69 kV. Since the present intertie is operated at 69 kV this concept requires two 138 kV, 2500 kVA transformers: one 69-138 kV transformer near Petersburg, and a 138-12.47 kV transformer at Kake with a 12.47 kV voltage regulator. The major disadvantage of this concept is the very high cost of 138 kV submarine cable as compared to 69 kV cable.

138 kV/69 kV Intertie Concept

We have considered a 138 kV/69 kV concept where the intertie is constructed with overhead transmission lines designed for 138 kV but operated at 69 kV, similar to the existing Tyee – Petersburg Intertie. For the submarine crossings we propose using 69 kV submarine cables in order to avoid the high cost of 138 kV submarine cable systems. When or if the Kake – Petersburg intertie is energized at 138 kV, the submarine crossings will be replaced with a 138 kV submarine cable system. Since present thinking is that this is not likely for at least another ten to fifteen years, the 69 kV submarine cables are likely to be approaching the end of their expected life and be ready for replacement anyway. Because this is initially less costly and is more in keeping with the present and near-future needs of the Kake community, we prefer this concept to the previously described 138 kV intertie concept. Other than a small increase in construction costs for the heavier 138 kV overhead construction this concept performs in a manner identical to the 69 kV Intertie concept.

DEVELOPMENT OF POWER FLOW COMPUTER MODELS AND STUDY CRITERIA

Starting with a computer model originally developed by Electric Power Systems, Inc. for the Tyee – Petersburg Ketchikan Transmission Project, CAI incorporated additional power flow modeling elements to include the project concepts described above. The original model had both of the circuits between Tyee and Swan Lake out-of-service. We assume that this was because these circuits are not presently in service. Because the Tyee Power Plant 69 kV bus, which the generators act to hold at a constant voltage, is the only interconnection point between the Ketchikan and Petersburg/Kake electrical system these two systems will not interact with each other. For this reason we decided to leave the ties between Tyee and Swan Lake out-of-service as originally modeled.

We added models for the 12.47 kV Kake electrical system and the numerous nodes proposed for the alternative transmission routes currently being evaluated. Models were created for the overhead transmission lines and the submarine cables to interconnect the model from Petersburg to Kake. The TRANSMISSION 2000® Power Flow program was used to perform numerous power flow simulations to determine the resulting transmission system flow and voltage levels for each of the major routing and operating voltage level alternatives.

A one-line diagram of the Kake/Petersburg/Tyee electrical system is shown in Exhibit C1. Exhibit C2 shows the distances and impedances for each of the map segments and the aggregate distance and impedance for each of the branches in the power flow model. Exhibit C3 is a bus report from the Power Flow program. The bus report shows branch power flows, voltages and impedances for the complete model developed for this study. In this particular report we have

Kake modeled with 2000 kW load and the Woewodski mine operating with 5000 kW load using the Center - South route (alternative routing segments are shown as being out-of-service).

Study Criteria

CAI recommends the following planning criteria.

- Under normal system conditions, voltages at load serving facilities should range from a maximum of 105 percent of nominal system voltage to a minimum of 95 percent.
- Maximum voltages for the Intertie transmission buses should not exceed 110 percent of nominal system voltage during energization procedures when no load is being served.
- Minimum voltages may sag to as little as 85 percent of nominal as long as there is no danger of voltage collapse for the non-load serving intertie transmission buses under heavy system load conditions.
- Facility loading should not exceed 100 percent of normal system seasonal ratings as specified by the manufacturers of the submarine cables, or for overhead transmission system, as determined based on standard conductor loadability.

CAI found that facilities are limited by voltage constraints and not by thermal limitations of transmission line loadability for the presently planned Kake – Petersburg Transmission Intertie Project.

DETERMINATION OF INTERTIE SYSTEM VOLTAGE LEVEL

As our subsequent analysis will confirm, 69 kV is the operating voltage we recommend for the Kake – Petersburg Transmission Intertie. We base this recommendation on a combination of reasons, including economics, anticipated future system needs, consistency with other sections of the Southeast Alaska Intertie Project, and technical feasibility.

The 138 kV concept would require two 138 kV, 2500 kVA transformers:, one at the Petersburg end of the Intertie and the other at the Kake end. The 138 kV option cost of 138 kV submarine cable is very high compared to submarine cable systems at 24.9 kV and 69 kV. The 138 kV concept was ruled out before detailed analysis, based primarily on the cost of this alternative.

Study of 69 kV Operation to Kake

The first major concern for this design is to service existing and anticipated future load in the Kake community and/or at the Woewodski mine. For this purpose we examined the ultimate loading capability of the Center - South (preferred) route at 69 kV. Initially we recommend a 69 kV circuit from the two breaker Sub-T and a 69-12.47 kV, 2500 kVA transformer at Kake Substation equipped and a 12.47 kV voltage regulator capable of plus or minus 10 percent voltage regulation. For the initial installation we do not see a need for capacitors at the Kake Substation.

Exhibit A1 shows the results from this study for 69 kV operation of the Intertie. Note that for testing of ultimate Intertie capacity we have added a second 2500 kVA transformer at the Kake

Substation. This second transformer is not needed for another ten years hence when the Kake load approaches the 2500 kVA capacity of the first 69-12.47 kV transformer. Without power factor compensating capacitors at Kake, Exhibit A, Case 4.3 shows that when the Kake load reaches 5200 kW at a pessimistic 86 percent power factor, the voltage on the 69 kV side of the Kake transformer drops to 85 percent of nominal voltage. In this same case we see that the voltage regulator holds the load 12.47 kV voltage at Kake to 94 percent. This offers a comfortable level of potential for the Kake community load growth; roughly five times the previous 1000 kW maximum peak demand. If growth beyond 5200 kW is desired, Case 5.2 shows that the future addition of a 2400 kVAr capacitor bank on the load side of the Kake transformer would allow demand to increase to 6800 kW before voltage constraints limit additional growth.

We also studied the possibility of operating both the Woewodski mine and Kake from the new 69 kV Intertie. Case 2.2 shows that with a mine load of 5000 kW and without power factor compensating capacitors at Kake the 69 kV Intertie can support a Kake load of up to 2800 kW before the 69 kV voltage drops to the 85 percent criteria. Adding 2400 kVAr of 12.47 kV capacitors at the Woewodski mine and Kake Substation can increase the Kake load to 5400 kW before the low 69 kV voltage limit is reached.

For this analysis we have considered three conductor sizes: 336, 266, and 4/0 ACSR conductors. All three are adequate for carrying the 7000 kVA ultimate voltage limited capability of the 69 kV transmission circuit intertie to Kake. Using Westinghouse transmission and distribution ratings as a conservative normal system rating, these conductors are capable of 530, 460, or 340 Amps, respectively. Assuming an ultimate load of 60 amps (7000 kVA at 69 kV) even the 4/0 ACSR conductor is loaded to less than 20 percent of its capacity.

Even so, CAI prefers the stronger 336 ACSR conductor for this project. The present intertie segment, Petersburg – Wrangell, uses 336 ACSR and, therefore, the two systems can share a common stock of spare conductor if the 336 ACSR conductor is used for this project. Next, the terrain traversed by the Kake – Petersburg Intertie is rough and much of it will be difficult to reach for timely maintenance. The additional mechanical strength of the 336 ACSR conductor should reduce the amount of maintenance required over the life of the intertie. A third point is that if the full plan for the Southeast Alaska Intertie Project is completed, the Sitka – Kake Transmission Intertie may require the additional capacity of the 336 ACSR conductor.

For the preferred Center - South route with 2000 kW load at Kake the losses on the Intertie using the 336 ACSR conductor were 19 kW (1 percent). Losses for the 266 and 4/0 ACSR conductors were 20 and 21 kW, respectively. Regarding costs for the transmission circuit, compared to 336 ACSR the 266 ACSR saves about \$670,000 in initial capitalization (3.1 percent), or after adjusting for life cycle losses it saves \$560,000 (2.6 percent) (see Exhibit A4). Similarly, compared to the 266 ACSR, the 4/0 saves an additional \$160,000 (0.8 percent), or after adjusting for life cycle losses, \$130,000 (0.6 percent). CAI feels that the advantages described for the 336 ACSR conductor are worth the small additional cost of using these conductors for the overhead transmission line portion of the project.

One last consideration for the 69 kV design concept is the possibility of over-voltage when energizing the unloaded transmission system resulting from line charging on both the submarine cables and the overhead lines. Exhibit A1, items 1.1 and 1.2, show the results for no load energization. Item 1.1 shows both Kake and Petersburg being energized together and item 1.2 shows the Kake energizing alone. Voltages on the 12.47 kV side of the Kake transformer range between 100.3 and 103.8 percent, which is less than the 105 percent criteria. On the 69 kV side of the transformer, voltages range between 103.9 and 108.3 percent: less than the 110 percent criteria for non-load buses.

Study of 24.9 kV Operation

The 24.9 kV design must also service the existing and anticipated future Kake or Woewodski Mine load. We examined the ultimate loading capability of the Center - South (preferred) route at 24.9 kV. For the design of the 24.9 kV alternative we recommend a 2500 kVA, 69-24.9 kV, transformer located at the new Sub-T. To achieve the highest future levels of power transfer to Kake we recommend that the range of Sub-T transformer taps be capable of providing an 8 percent boost in the 24.9 kV voltage at Sub-T. At the new Kake Substation we recommend a 2500 kVA, 12.47 kV transformer capable of plus or minus 10 percent voltage regulation.

Exhibit A2 shows the results from this study for 24.9 kV operation of the Intertie. Case 7.4 (Exhibit A2) shows that using the 8 percent boost from the transformer taps at Sub-T, the simulated voltage drop limits the ultimate load at Kake without power factor compensation to 1700 kW at a power factor of 86 percent. At this load level the line-side voltage drops to just over 85 percent of nominal voltage while the 12.47 kV voltage regulator is able to hold the load-side voltage at Kake to 97 percent.

Case 8.4 (Exhibit A2) shows that Kake load can increase to 2460 kW with the addition of a 1200 kVAr capacitor at Kake. Note that in this instance we have recommended that the 24.9 kV voltage at Kake should not be allowed to drop below 90 percent. We found that when attempting to solve the power flow, as 24.9 kV voltage levels got close to 85 percent the power flow solution became extremely difficult (the cases diverged). Our further analysis showed that the nose curve for the Kake system reached its maximum at about 2640 kW and just below 85 percent voltage. The nose curve identifies the point where voltage collapse is likely to occur. In cases 8.5 and 8.6 you can observe that a mere 10 kW change (0.4%) in Kake load causes the voltage to drop by almost a full one percent (0.72%). CAI recommends that for this circumstance a margin of 5 percent be maintained away from the nose point.

CAI does not feel that this plan allows the Kake community adequate room for future growth, especially since during the early years, right after the Kake community experiences a drop in the cost of electrical energy of about a factor of 10, there is likely to be a short term but significant spurt in the growth of electrical demand.

If the Kake community reaches the ultimate future peak load level of 2400 kW, the Sub-T transformer tap must be set to provide an 8 percent boost in order to hold minimum voltage during peak load. With the system set up in this fashion the possibility of over-voltage when re-

energizing the Kake transmission system following an outage is possible. This problem occurs even though line charging from both submarine cables and overhead lines is reduced by a factor of nearly eight at 24.9 kV as compared to the 138 kV alternative. Our simulations show that a no-load energization on the line side voltage at the Kake regulator reaches 109.7 percent of nominal voltage and the load side voltage reaches 105.1 percent (Exhibit A2, item 6.1).

Between the low voltage limit for a peak Kake load of 2000 kW and the high voltage limit for no load energization, the 24.9 kV concept has an upper limit of 2000 kW for Kake system growth. In reaching this limit we have maximized the utilization of transformer taps at both the source and receiving ends of the circuit with active voltage regulation at the Kake end. By conventional standards we have also maximized the utilization of reactive compensation with the use of 1200 kVAR of capacitive compensation at Kake Substation resulting in unity power factor as seen on the 24.9 kV Intertie. Use of less conventional power system technologies, such as series compensation or active voltage control through electronically switched reactive compensation, might further extend the potential life of this concept, but these technologies are imposed only when simpler and cheaper alternatives are not available. The simple selection of a higher system voltage for the Intertie is a much more conventional, economical, and robust choice if made now.

CONCLUSIONS AND RECOMMENDATIONS

CAI recommends operating the Kake-Petersburg Intertie at 69 kV using 336 kcmil ACSR conductors. While it is tempting to construct the overhead portions of the Intertie for future 138 kV operation in order to maintain consistency with other segments of the Alaska Intertie Project, the small additional cost and lack of technical need causes us to recommend the Intertie be constructed to meet 69 kV construction standards.

APPENDIX A
EXHIBITS

Exhibit A1
69 kV Voltage Analysis
for the Center - North (Primary Route)
Kake - Petersburg 69 kV Intertie

Case	Kake Load			Kake Cap.	Line Side Voltage	Load Side Voltage	Regulator Tap	Mine Load	Mine Cap.	Load Side Voltage	Regulator Tap
	kW	kVAr	kVAr	kVAr	69 kV	12.47 kV	12.47 kV	kW	kVAr	12.47 kV	12.47 kV
1.1	*	0	0		1.08311	1.03801	1.0450 max	0	0	1.02893	1.0450 max
1.2	0	0			1.03920	1.00314	1.0375	0	0	1.00037	1.0313
2.1	2000	1200			0.87528	0.99861	0.8609	5000	3000	0.99713	0.8550 min
2.2	2800	1680			0.85 Est.	0.972	0.8550 min	5000	3000	Est. 0.972	0.8550 min
2.3	3000	1800			0.84618	0.96120	0.8550 min	5000	3000	0.96479	0.8550 min
2.4	4000	2400			0.80723	0.90163	0.8550 min	5000	3000	0.93054	0.8550 min
3.1	4000	2400	1200		0.93252	0.99737	0.9312	5000	3000	1.00274	0.9250
3.2	5000	3000	1200		0.88394	1.01168	0.8625	5000	3000	0.99755	0.8938
3.3	5400	3240	1200		0.85 Est.	0.97	0.8550 min	5000	3000	Est. 1.0	0.8550 min
3.4	5500	3300	1200		0.84101	0.96003	0.8550 min	5000	3000	1.00781	0.8550 min
4.1	4000	2400			0.91581	1.00105	1.0000	With Out Woewodski Mine Tap			
4.2	5000	3000			0.86808	0.96457	0.8550 min				
4.3	5200	3120			0.85 Est.	0.942	0.8550 min				
4.4	6000	3600			0.78998	0.85268	0.8550 min				
5.1	6000	3600	1200		0.91221	1.00331	1.0375				
5.2	6800	4080	1200		0.85 Est.	0.965	0.8550 min				
5.3	7000	4200	1200		0.83829	0.93706	0.8550 min				
5.4	7300	4380	1200		0.78901	0.86566	0.8550 min				

* Also Zero Load at Petersburg

Note: Regulators at both Kake and the Mine provide a plus or minus 10% tap range with a 5.8% voltage boost (1/0.945) at mid range.

Exhibit A2
24.9 kV Voltage Analysis
for the Center - North (Primary Route)
Kake - Petersburg 24.9 kV Intertie

Case	Kake Load kW	Kake Cap. kVAr	Line Side Voltage 24.9 kV	Load Side Voltage 12.47 kV	Regulator Tap 12.47 kV	Mine Load kW	Mine Cap. kVAr	Line Side Voltage 24.9 kV	Load Side Voltage 12.47 kV	Regulator Tap 12.47 kV					
6.1	0	0	1.09736	1.05011	1.045	max									
7.1	1000	600	0.98206	0.99945	0.96375										
7.2	1200	720	0.95216	0.99744	0.93250										
7.3	1500	900	0.90024	0.99790	0.87625										
7.4	1730	1038	0.84990	0.97044	0.845	min									
7.5	2000	1200	0.73270	0.85196	0.845	min									
								With Out Woewodski Mine Tap							
8.1	2000	1200	1200	0.99101	1.00323	0.98125									
8.2	2200	1320	1200	0.95687	1.00145	0.94375									
8.3	2460	1476	1200	0.90264	1.00085	0.88875									
8.4	2600	1560	1200	0.86075	1.00221	0.845	min								
8.5	2630	1578	1200	0.85455	0.99468	0.845	min								
8.6	2640	1584	1200	0.84729	0.98603	0.845	min								
9.1								0	0	1.08005	1.03354	1.0450	max		
10.1								3000	1800	0.94707	1.00148	0.9437			
10.2								4000	2400	0.87771	1.00036	0.8750			
10.3								4300	2580	0.85	Est.	0.985	0.8550	min	
10.4								4500	2700	0.83207	0.97000	0.8550	min		
10.5								5000	3000	0.77332	0.90066	0.8550	min		
	With Out Kake Intertie														
11.1								5000	3000	2400	0.95305	1.00228	0.9500		
11.2								6000	3600	2400	0.87172	1.00179	0.8687		
11.3								6100	3660	2400	0.85	Est.	0.996	0.8550	min
11.4								6300	3780	2400	0.79490	0.96005	0.8550	min	
11.5								6500	3900	2400	0.75484	0.87996	0.8550	min	

Notes:

1. 69-24.9 KV Transformer at node "T" provides an 8% voltage boost
 2. Regulators at either Kake or the Mine provide a plus or minus 10% tap range with a 5.8% voltage boost ($1/0.945$) at mid range.

Exhibit A3
Kake to Petersburg
Southeast Alaska Intertie
New Single Circuit Transmission Line with Fiber Cable
Project Cost Estimate per Mile*
Center – South Alternative
138kV

	<u>24.9kV</u> per mile	<u>34.5kV</u> per mile	<u>69kV</u> per mile	<u>138kV</u> per mile
4/0 kcmil	\$224,318	\$224,318	\$249,651	\$306,369
266 kcmil	\$227,099	\$227,099	\$252,432	\$309,150
336 kcmil	\$246,651	\$246,651	\$271,984	\$328,702
Additional Cost For: [1]				
A) 138 kV Construction	\$82,051	\$82,051	\$56,718	
B1) 138 kV Insulation			\$12,844	
B2) 69 kV Insulation	\$24,223	\$24,223		
B3) 34.5 kV Insulation	\$0			

[1] Note: This table is intended to provide an overview and comparison for only the Transmission Line costs. This table does not include the Submarine cable, switchyard, substation or indirect costs.

How to use the table:

For example, if the transmission Line were built to 138 kV specifications, 75 ft. ROW, and 336 kcmil, the estimated cost would be \$328,702 per mile. However, if the project elected to use this design but only energize the Transmission Line at 69 kV, the project would have spent an extra \$56,718 (per mile) for slightly taller poles, heavier construction and \$12,844 (per mile) for heavier insulators.

*Total direct OH Transmission estimate and clearing road construction (cost/mile)

$$\frac{\$16,468,000}{50.1 \text{ miles}} = \$328,702 / \text{mile} \quad 138\text{kV}$$

Exhibit A4
Cost of Losses for the First 30 Years of the Project
For the Preferred Route

Year	Annual Growth Rate	Kake Demand	Annual Cost	Cumulative Costs	Center - South	Use of 336 ACSR
	MW	\$	\$	Ploss=19	R = 0.306	
2003	0.61%	1.000	1582		0.61%	Expected Pre-project Growth
2004	0.61%	1.006	1596		14.87%	Annual Growth for First Five Years
2005	0.61%	1.012	1611		0.90%	Expected Long Term Growth
2006	0.61%	1.018	1625			
2007	18.30%	1.205	2066	2066		
2008	15.90%	1.396	2519	4585		
2009	14.87%	1.604	3213	7798		
2010	13.63%	1.823	4156	11955		
2011	11.76%	2.037	5124	17079		
2012	5.20%	2.143	5702	22781	5 Years	
2013	1.67%	2.179	5898	28678		
2014	0.90%	2.198	6005	34683		
2015	0.90%	2.22	6113	40796		
2016	0.90%	2.24	6222	47017		
2017	0.90%	2.26	6332	53349	10 Years	
2018	0.90%	2.28	6442	59792		
2019	0.90%	2.30	6554	66346		
2020	0.90%	2.32	6667	73013		
2021	0.90%	2.34	6781	79795		
2022	0.90%	2.36	6896	86691	15 Years	
2023	0.90%	2.383	7012	93703		
2024	0.90%	2.404	7129	100832		
2025	0.90%	2.43	7247	108080		
2026	0.90%	2.45	7367	115446		
2027	0.90%	2.47	7487	122933	20 Years	
2028	0.90%	2.49	7608	130541		
2029	0.90%	2.51	7771	138312		
2030	0.90%	2.54	7957	146269		
2031	0.90%	2.56	8145	154414		
2032	0.90%	2.58	8334	162748	25 Years	
2033	0.90%	2.606	8526	171273		
2034	0.90%	2.630	8718	179992		
2035	0.90%	2.65	8913	188905		
2036	0.90%	2.68	9110	198014		
2037	0.90%	2.70	9308	207322	30 Years	
Net Present Worth (3%)			124823		5944	
					11888	
					157049	
					197841	

Energy Cost (\$/kWhr) = 6.8%			
LoadFactor = 58%			
LossFactor = 39%			
Peak Kake Load	Cost of Annual Losses	dCost	dLoad
MW	\$	\$	MW
1	1582	1183	0.5
1.5	2764	2158	0.5
2	4922	2729	0.5
2.5	7651	4113	0.5
3	11764	5028	0.5
3.5	16792	6129	0.5
4	22921	7031	0.5
4.5	29953	8816	0.5
5	38769	4051	0.2
5.2	42820	3400	0.2
5.4	46220		

266 ACSR vs 336	4/0 ACSR vs 266
Added Cost for Larger Conductor:	1141837
Life Cycle Savings in Losses:	-157049
	984788
	121618

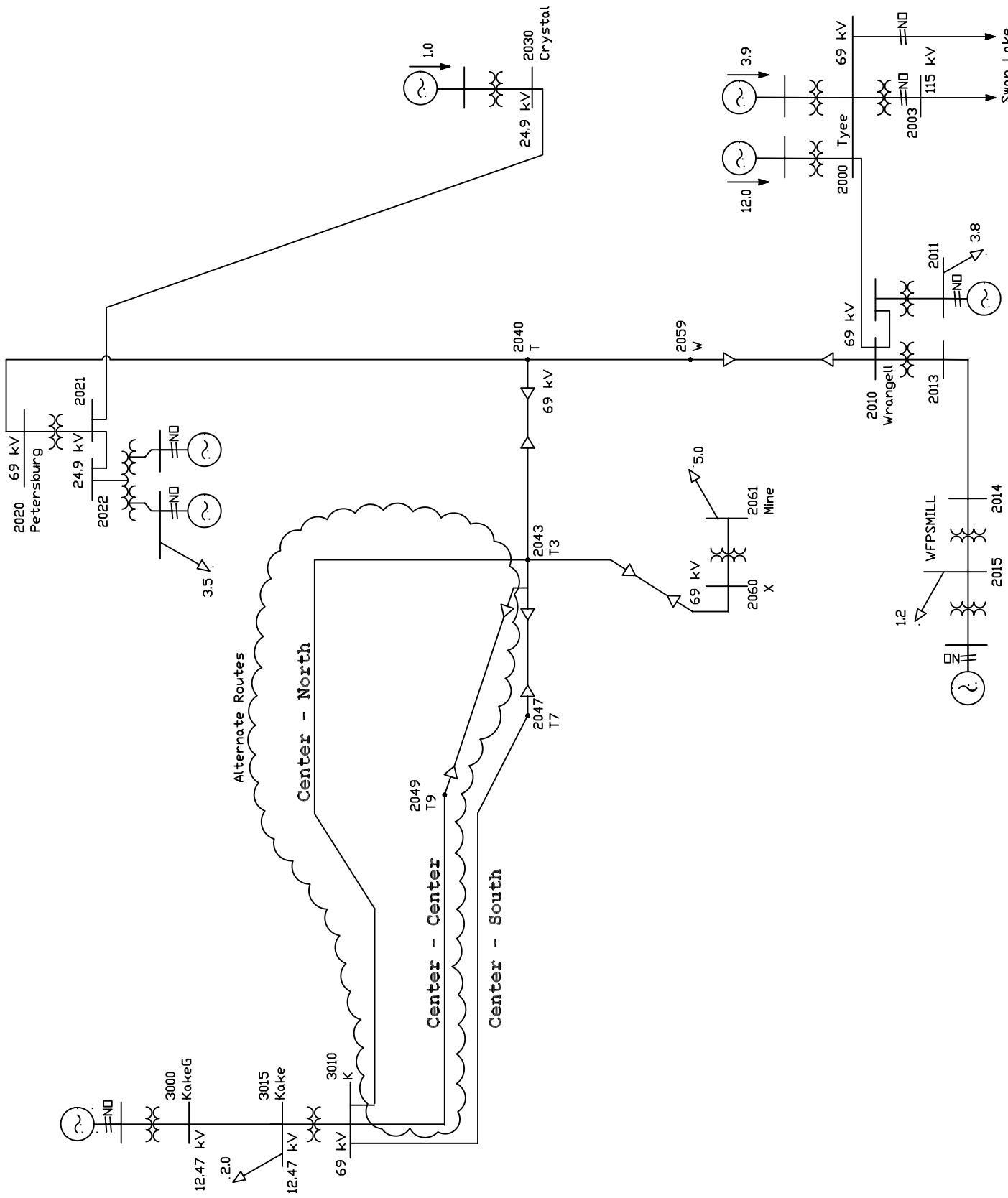
Loss Saving as a percent of Transmission Circuit Cost 0.7% 0.2%

APPENDIX B

ROUTE ALTERNATIVES MAP

APPENDIX C
POWER FLOW RESULTS

**One Line Diagram of the
KAKE to PETERSBURG INTERtie**



CIRCUIT IMPEDANCES FOR THE 69 kV KAKE to PETERSBURG INTERTIE

Map Nodes	Pflow Model	Miles	R	X	B
T - T1	2040-	0.92	0.005961	0.013331	0.000270
T1 - T2 S		0.56	0.003996	0.003142	0.002142
T2 - T3	-2043	1.46	0.009409	0.021042	0.000427
		2.93	0.019366	0.037514	0.002839
T3 - T6	2043-	9.19	0.059385	0.132804	0.002693
T6 - T7 S	-2047	1.08	0.007763	0.006103	0.004162
		10.27	0.067148	0.138907	0.006855
T7 - T11	2047-2051	15.04	0.097201	0.217376	0.004408
T3 - T10	2043-	11.65	0.075249	0.168282	0.003412
T10 - T9 S	-2049	4.94	0.035583	0.027972	0.019076
		16.59	0.110831	0.413629	0.026897
T9 - T11	2049-2051	8.54	0.055207	0.123461	0.002504
T3 - T12	2043-	7.57	0.048924	0.109411	0.002219
T12 - T13 S		0.87	0.006270	0.004929	0.003362
T13 - W4		1.95	0.012602	0.028182	0.000571
W4 - X	-2060	3.19	0.020619	0.046111	0.000935
		13.58	0.088415	0.188633	0.007087
T3 - T5	2043-	12.47	0.080557	0.180154	0.003653
T5 - S3		11.38	0.073550	0.164483	0.003335
S3 - S4		9.75	0.062964	0.140809	0.002855
S4 - S5	-3010	12.19	0.078728	0.176064	0.003570
S5 - K		10.25	0.066198	0.148041	0.003002
		56.03	0.361998	0.809550	0.016416
T11 - K	2051-3010	23.32	0.150663	0.336933	0.006832

S - Submarine Cable (3 - 4/0 Cu)

69 kV Routes	Pflow Model	Miles	R	X	B
Center - South (Preferred)	2040-2043	2.93	0.019366	0.037514	0.002839
	2043-2047	10.27	0.067148	0.138907	0.006855
	2047-3010	38.36	0.247864	0.554309	0.011240
	Total	51.57	0.334378	0.730730	0.020935
Center - Center	2040-2043	2.93	0.019366	0.037514	0.002839
	2043-2049	16.59	0.110831	0.196254	0.022489
	2049-3010	31.86	0.205869	0.460394	0.009336
	Total	51.39	0.336067	0.694161	0.034664
Center - North	2040-2043	2.93	0.019366	0.037514	0.002839
	2043-3010	56.03	0.361998	0.809550	0.016416
	Total	58.96	0.381364	0.847064	0.019256
Center - Woewodski Tap	2043-2060	13.58	0.088415	0.188633	0.007087

Exhibit C3

SOUTHEAST ALASKA INTERTIE PROJECT
 Kake to Petersburg Intertie
 Base Case 69 kV Center - South Route

3010 K	Area	3	Kake	Zone	4	Kake	69.00	kV	Load
Voltage	Angle		[----LOAD----]	[--GENERATION--]	[---SHUNTS---				
0.8808* 60.774 kV	13.939		0.0	0.0					
<hr/>									
Line flows to									
2043 T3	C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg %Rate3
2047 T7	1	0.000	0.000 *		0.0000	0.0000	63	0.0	0.0
2049 T9	1	-2.010	-1.245 L	0.0146	-0.7553	63	3.8	3.8	
3015 Kake	1	0.000	0.000 *		0.0000	0.0000	63	0.0	0.0
3015 Kake	2	2.010	1.246 V	0.0093	0.1487	2	118.2*	118.2*	
		0.000	0.000 *		0.0000	0.0000	3	0.0	0.0
<hr/>									
3015 Kake	Area	3	Kake	Zone	4	Kake	12.47	kV	Load
Voltage	Angle		[----LOAD----]	[--GENERATION--]	[---SHUNTS---				
1.0058 12.542 kV	40.887		2.00000	1.20000					
Line flows to									
3000 KakeG	C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg %Rate3
3010 K	1	-0.000	-0.104 L	0.0000	-0.1044	63	0.2	0.2	
3010 K	T 1	-2.001	-1.097 V	0.0093	0.1487	2	114.1*	114.1*	
	2	0.000	0.000 *		0.0000	0.0000	3	0.0	0.0
<hr/>									
3001 Kake #1	Area	3	Kake	Zone	4	Kake	4.160	kV	V Gen (L)
Voltage	Angle		[----LOAD----]	[--GENERATION--]	[---SHUNTS---				
1.0058 4.1842 kV	70.886		0.0	0.0	0.0	0.0			
Gen MVAr Max:	0.0	Min:	0.00	Contrld bus:	3000 KakeG	Volt:	1.0100		
Line flows to									
3000 KakeG	C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg %Rate3
	T 1	0.000	-0.000 F	0.0000	0.0000	2	0.0	0.0	
<hr/>									
3000 KakeG	Area	3	Kake	Zone	4	Kake	12.47	kV	Load
Voltage	Angle		[----LOAD----]	[--GENERATION--]	[---SHUNTS---				
1.0058 12.543 kV	40.886		0.0	0.0					
Line flows to									
3001 Kake #1	C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg %Rate3
3015 Kake	1	-0.000	0.000 F	0.0000	0.0000	2	0.0	0.0	
	1	0.000	-0.000 L	0.0000	-0.1044	63	0.0	0.0	
<hr/>									
2040 T	Area	2	Ptrsbr	Zone	2	Tyee	69.00	kV	Load
Voltage	Angle		[----LOAD----]	[--GENERATION--]	[---SHUNTS---				
0.8975* 61.929 kV	15.191		0.0	0.0					
Line flows to									
2020 PTRSBURG	C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg %Rate3
2043 T3	1	2.654	-0.010 L	0.0024	-0.2185	53	5.0		
2059 W	1	7.103	2.608 L	0.0140	-0.1932	23	32.9	32.9	
	1	-9.757	-2.598 L	0.0973	-0.3748	53	19.1		
<hr/>									
2043 T3	Area	3	Kake	Zone	5	Intertie	69.00	kV	Load
Voltage	Angle		[----LOAD----]	[--GENERATION--]	[---SHUNTS---				
0.8946* 61.725 kV	14.994		0.0	0.0					
Line flows to									
2040 T	C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg %Rate3
2047 T7	1	-7.089	-2.802 L	0.0140	-0.1932	23	33.1	33.1	
2049 T9	1	2.028	-0.112 L	0.0034	-0.6021	59	3.4	3.4	
2060 X	1	0.000	0.000 *		0.0000	0.0000	59	0.0	0.0
3010 K	1	5.062	2.913 L	0.0386	-0.4431	59	9.9	9.9	
	1	0.000	0.000 *		0.0000	0.0000	63	0.0	0.0

Exhibit C3

2047 T7	Area	3 Kake	Zone	5 Intertie	69.00 kV	Load
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]				
0.8927* 61.598 kV	14.763	0.0	0.0			
Line flows to						
	C	MW	MVAr	T	MW/MVar Loss	Norm %Norm %Emrg %Rate3
2043 T3	1	-2.024	-0.490	L	0.0034 -0.6021	59 3.5 3.5
3010 K	1	2.024	0.490	L	0.0146 -0.7553	63 3.3 3.3
2049 T9	Area	3 Kake	Zone	5 Intertie	69.00 kV	Outaged
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]				
1.0037 69.255 kV	23.724	0.0	0.0			
Line flows to						
	C	MW	MVAr	T	MW/MVar Loss	Norm %Norm %Emrg %Rate3
2043 T3	1	0.000	0.000 *	0.0000 0.0000	59 0.0 0.0	
3010 K	1	0.000	0.000 *	0.0000 0.0000	63 0.0 0.0	
2059 W	Area	2 Ptrsbr	Zone	2 Tyee	69.00 kV	Load
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]				
0.9118* 62.915 kV	16.556	0.0	0.0			
Line flows to						
	C	MW	MVAr	T	MW/MVar Loss	Norm %Norm %Emrg %Rate3
2010 WRANGELL	1	-9.854	-2.225	L	0.0695 -7.1420	53 19.1
2040 T	1	9.854	2.223	L	0.0973 -0.3748	53 19.1
2060 X	Area	3 Kake	Zone	6 Mine	69.00 kV	Load
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]				
0.8816* 60.831 kV	14.356	0.0	0.0			
Line flows to						
	C	MW	MVAr	T	MW/MVar Loss	Norm %Norm %Emrg %Rate3
2043 T3	1	-5.023	-3.356	L	0.0386 -0.4431	59 10.2 10.2
2061 Mine	1	5.024	3.358	V	0.0220 0.3541	7 86.3 86.3
2061 Mine	Area	3 Kake	Zone	6 Mine	12.47 kV	Load
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]				
0.9956 12.415 kV	41.583	5.00000	3.00000			
Line flows to						
	C	MW	MVAr	T	MW/MVar Loss	Norm %Norm %Emrg %Rate3
2060 X	T 1	-5.002	-3.004	V	0.0220 0.3541	7 83.4 83.4
2020 PTRSBURG	Area	2 Ptrsbr	Zone	3 Ptrsburg	69.00 kV	Load
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]				
0.8966* 61.866 kV	15.047	0.0	0.0			
Line flows to						
	C	MW	MVAr	T	MW/MVar Loss	Norm %Norm %Emrg %Rate3
2010 WRANGELL	1	0.000	0.000 *	0.0000 0.0000	53 0.0	
2021 PTRSBURG	1	2.652	0.208	F	0.0036 0.0645	12 22.2 13.3
2040 T	1	-2.651	-0.208	L	0.0024 -0.2185	53 5.0
2021 PTRSBURG	Area	2 Ptrsbr	Zone	3 Ptrsburg	24.90 kV	Load
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]				
0.8940* 22.260 kV	13.664	0.0	0.0			
Line flows to						
	C	MW	MVAr	T	MW/MVar Loss	Norm %Norm %Emrg %Rate3
2020 PTRSBURG	T 1	-2.648	-0.144	F	0.0036 0.0645	12 22.1 13.3
2022 PTRSBURG	1	3.602	1.512	L	0.0388 0.0631	
2030 CRYSTAL	1	-0.954	-1.368	L	0.0386 0.0627	

Exhibit C3

```

-----
2022 PTRSBURG      Area 2 Ptrsbr Zone 3 Ptrsbburg    24.90 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.8802* 21.918 kV 13.021     0.0     0.0

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
2021 PTRSBURG     1   -3.563   -1.449 L  0.0388  0.0631
2025 2022_MP      1    3.564    1.449 F  0.0112  0.1574     8   48.1  48.1

-----
2023 PTRSBURG      Area 2 Ptrsbr Zone 3 Ptrsbburg    4.160 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.8649* 3.5980 kV 10.875     0.0     0.0

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
2025 2022_MP      1   0.000    0.000 F  0.0000  0.0000     8   0.0   0.0

-----
2024 PTRSBURG      Area 2 Ptrsbr Zone 3 Ptrsbburg    2.400 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.8534* 2.0481 kV -20.917   3.54200 1.16400

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
2025 2022_MP      1   -3.544   -1.164 F  0.0092  0.1274     8   46.6  46.6

-----
2025 2022_MP      Area 2 Ptrsbr Zone 3 Ptrsbburg    100.0 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.8649* 86.490 kV 10.875     0.0     0.0

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
2022 PTRSBURG     T 1   -3.553   -1.292 F  0.0112  0.1574     8   47.3  47.3
2023 PTRSBURG     T 1   0.000    0.000 F  0.0000  0.0000     8   0.0   0.0
2024 PTRSBURG     T 1   3.553    1.292 F  0.0092  0.1274     8   47.3  47.3

-----
2030 CRYSTAL       Area 2 Ptrsbr Zone 3 Ptrsbburg    24.90 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9334* 23.241 kV 13.804     0.0     0.0

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
2021 PTRSBURG     1   0.993    1.431 L  0.0386  0.0627
2031 CRYSTAL       1   -0.993   -1.431 F  0.0070  0.0693     3   58.1  58.1

-----
2031 CRYSTAL       Area 2 Ptrsbr Zone 3 Ptrsbburg    2.400 kV V Gen (H)
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9662 2.3188 kV -15.122     0.0     0.0   1.00000 1.50000

Gen MVar Max:    1.5 Min: -0.75 Contrld bus: 2031 CRYSTAL Volt: 1.0100

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
2030 CRYSTAL       T 1   1.000    1.500 F  0.0070  0.0693     3   60.1  60.1

```

Exhibit C3

2010 WRANGELL		Area	2	Ptrsbr	Zone	2	Tyee	69.00 kV	Load		
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]									
0.9153*	63.158 kV	17.906			0.0	0.0		-6.2838			
Line flows to		C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg	%Rate3
2000	TYEE	1	-14.906	-3.298	L	0.8744	-0.4884	39	39.1		
2011	WRANGELL	1	3.794	1.459	L	0.0023	0.0098				
2013	WRANGELL	1	1.192	0.470	F	0.0031	0.0396	4	32.0	32.0	
2020	PTRSBURG	1	0.000	0.000	*	0.0000	0.0000	53	0.0		
2059	W	1	9.923	-4.917	L	0.0695	-7.1420	53	20.9		

2011 WRANGELL		Area	2	Ptrsbr	Zone	2	Tyee	69.00 kV	Load		
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]									
0.9141*	63.071 kV	17.788			0.0	0.0					
Line flows to		C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg	%Rate3
2010	WRANGELL	1	-3.792	-1.449	L	0.0023	0.0098				
2012	WRANGELL	1	3.792	1.449	F	0.0127	0.2066	8	50.7	40.6	

2012 WRANGELL		Area	2	Ptrsbr	Zone	2	Tyee	12.47 kV	Load		
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]									
0.8958*	11.171 kV	15.072			3.77800	1.24200					
Line flows to		C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg	%Rate3
2011	WRANGELL	T 1	-3.779	-1.242	F	0.0127	0.2066	8	49.7	39.8	

2013 WRANGELL		Area	2	Ptrsbr	Zone	2	Tyee	24.90 kV	Load		
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]									
0.9033*	22.491 kV	-13.713			0.0	0.0					
Line flows to		C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg	%Rate3
2010	WRANGELL	T 1	-1.189	-0.431	F	0.0031	0.0396	4	31.6	31.6	
2014	WFPSMILL	1	1.189	0.431	L	0.0032	0.0034				

2014 WFPSMILL		Area	2	Ptrsbr	Zone	2	Tyee	24.90 kV	Load		
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]									
0.9003*	22.418 kV	-13.808			0.0	0.0					
Line flows to		C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg	%Rate3
2013	WRANGELL	1	-1.185	-0.428	L	0.0032	0.0034				
2015	WFPSMILL	1	1.186	0.427	F	0.0044	0.0394	2	63.0	42.0	

2015 WFPSMILL		Area	2	Ptrsbr	Zone	2	Tyee	2.400 kV	Load		
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]									
0.9349*	2.2438 kV	-45.448			1.18100	0.38800					
Line flows to		C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg	%Rate3
2014	WFPSMILL	T 1	-1.181	-0.388	F	0.0044	0.0394	2	62.2	41.5	
2016	WFPSMILL	1	0.000	-0.000	F	-0.0000	-0.0000	3	0.0	0.0	

2016 WFPSMILL		Area	2	Ptrsbr	Zone	2	Tyee	0.480 kV	Load		
Voltage	Angle	[----LOAD----][--GENERATION--][---SHUNTS---]									
0.9349*	0.4488 kV	-75.448			0.0	0.0					
Line flows to		C	MW	MVAr	T	MW/MVar	Loss	Norm	%Norm	%Emrg	%Rate3
2015	WFPSMILL	T 1	-0.000	0.000	F	-0.0000	-0.0000	3	0.0	0.0	

Exhibit C3

```

-----
2000 TYEE      Area 2 Ptrsbr Zone 2 Tyee      69.00 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9937 68.562 kV 24.961     0.0     0.0

Line flows to   C   MW       MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1181 SWAN LK   1   0.000   0.000 *  0.0000 0.0000    39   0.0
2001 TYEE 1    1  -11.891  -0.923 F  0.0666 1.0731    11 108.4* 79.5
2002 TYEE 2    1  -3.891  -1.886 F  0.0087 0.1411    11 39.3   28.8
2003 TYEE      1   0.000   0.000 *  0.0000 0.0000    25   0.0   0.0
2010 WRANGELL  1  15.780   2.810 L  0.8744 -0.4884    39  41.1

-----
2003 TYEE      Area 2 Ptrsbr Zone 2 Tyee      115.0 kV Outaged
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0000 115.00 kV 30.000     0.0     0.0

Line flows to   C   MW       MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1180 SWAN LK   1   0.000   0.000 *  0.0000 0.0000    64   0.0
2000 TYEE      1   0.000   0.000 *  0.0000 0.0000    25   0.0   0.0

-----
2001 TYEE 1    Area 2 Ptrsbr Zone 2 Tyee      13.80 kV Reference
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0100 13.938 kV 0.000     0.0     0.0  11.9573 2.00132

Line flows to   C   MW       MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
2000 TYEE      T 1  11.957   1.996 F  0.0666 1.0731    11 110.2* 80.8

-----
2002 TYEE 2    Area 2 Ptrsbr Zone 2 Tyee      13.80 kV V Gen
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0100 13.938 kV -3.434     0.0     0.0  3.90000 2.03324

Gen MVar Max: 12.0 Min: -6.00 Contrlrd bus: 2002 TYEE 2 Volt: 1.0100

Line flows to   C   MW       MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
2000 TYEE      T 1  3.900    2.028 F  0.0087 0.1411    11 40.0   29.3

-----
1180 SWAN LK   Area 1 Ktchkn Zone 1 Ketchikan  115.0 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0150 116.73 kV 27.000     0.0     0.0

Line flows to   C   MW       MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1150 BAIL-SWN  1  15.929   4.881 L  0.1989 -1.6036    61 27.3
1181 SWAN LK   1   0.000   0.000 *  0.0000 0.0000    25   0.0   0.0
1190 SWAN LK   T 1 -15.929  -4.881 F  0.0431 0.9429    20 83.3
2003 TYEE      1   0.000   0.000 *  0.0000 0.0000    64   0.0

-----
1181 SWAN LK   Area 1 Ktchkn Zone 2 Tyee      69.00 kV Outaged
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0000 69.000 kV 30.000     0.0     0.0

Line flows to   C   MW       MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1180 SWAN LK   1   0.000   0.000 *  0.0000 0.0000    25   0.0   0.0
2000 TYEE      1   0.000   0.000 *  0.0000 0.0000    39   0.0

-----
1190 SWAN LK   Area 1 Ktchkn Zone 1 Ketchikan  13.80 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0099 13.937 kV -0.003     0.0     0.0

Line flows to   C   MW       MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1180 SWAN LK   1  15.972   5.824 F  0.0431 0.9429    20 85.0
1191 SWAN LK1  1  -7.973  -2.925 L  0.0007 0.0007    20 42.5
1192 SWAN LK2  1  -7.999  -2.899 L  0.0007 0.0007    20 42.5

```

Exhibit C3

```

-----
1191 SWAN LK1      Area 1 Ktchkn Zone 1 Ketchikan    13.80 kV Reference
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0100 13.938 kV  0.000     0.0     0.0   7.97390  2.92562

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1190 SWAN LK      1   7.974    2.926 L  0.0007  0.0007   20  42.5

-----
1192 SWAN LK2      Area 1 Ktchkn Zone 1 Ketchikan    13.80 kV V Gen
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0100 13.938 kV  0.000     0.0     0.0   8.00000  2.89953

Gen MVAr Max: 12.0 Min: -5.00 Contrld bus: 1192 SWAN LK2 Volt: 1.0100

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1190 SWAN LK      1   8.000    2.900 L  0.0007  0.0007   20  42.5

-----
1140 BAILEY        Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9886 34.107 kV -8.396     0.0     0.0

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1130 BETHE         1   8.548    2.182 L  0.0183  0.0350   40  22.1
1150 BAIL-SWN      1  -15.669   -5.126 F  0.0614  1.3586   20  82.4
1160 BAILEY G3     T  1  -0.000    0.000 F -0.0000 -0.0000   10  0.0
1165 BAILEY G4     T  1  -0.000    0.000 F -0.0000 -0.0000   10  0.0
1170 BAILEY G      T  1  -0.000    0.000 F -0.0000 -0.0000    5  0.0
1200 WRDCOVE        1   7.122    2.944 L  0.0990  0.1404   12  64.2

-----
1150 BAIL-SWN      Area 1 Ktchkn Zone 1 Ketchikan    115.0 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9954 114.47 kV  25.892     0.0     0.0

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1140 BAILEY         T 1  15.730    6.484 F  0.0614  1.3586   20  85.1
1180 SWAN LK         1  -15.730   -6.484 L  0.1989 -1.6036   61  27.9

-----
1170 BAILEY G      Area 1 Ktchkn Zone 1 Ketchikan    4.160 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9886 4.1126 kV -38.396     0.0     0.0

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1140 BAILEY         1   0.000    -0.000 F -0.0000 -0.0000    5  0.0

-----
1160 BAILEY G3     Area 1 Ktchkn Zone 1 Ketchikan    4.160 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9886 4.1126 kV -38.396     0.0     0.0

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1140 BAILEY         1   0.000    -0.000 F -0.0000 -0.0000   10  0.0

-----
1165 BAILEY G4     Area 1 Ktchkn Zone 1 Ketchikan    4.160 kV Q Gen
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9886 4.1126 kV -38.396     0.0     0.0     0.0     0.0

Generator Volt Max: 1.5000 Min: 0.5000

Line flows to      C   MW       MVAr T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1140 BAILEY         1   0.000    -0.000 F -0.0000 -0.0000   10  0.0

```

Exhibit C3

```

-----
1130 BETHE      Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9856 34.005 kV -8.588     0.0     0.0

Line flows to   C   MW       MVar T  MW/MVar Loss  Norm %Norm %Emrg %Rate3
1120 PORTWEST   1   3.297   0.053 L  0.0009  0.0026   23  14.3
1131 BETHE      T 1  5.232   2.093 V  0.0320  0.3844    5 112.7*
1140 BAILEY     1   -8.529  -2.147 L  0.0183  0.0350   40  22.0

-----
1131 BETHE      Area 1 Ktchkn Zone 1 Ketchikan    4.160 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9993 4.1571 kV -42.202  5.20000  1.70900

Line flows to   C   MW       MVar T  MW/MVar Loss  Norm %Norm %Emrg %Rate3
1130 BETHE      1   -5.200  -1.709 V  0.0320  0.3844   5 109.5*

-----
1010 BFALLS     Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0136 34.968 kV -6.450     0.0     0.0

Line flows to   C   MW       MVar T  MW/MVar Loss  Norm %Norm %Emrg %Rate3
1000 SILVIS    1   -1.984  0.522 L  0.0036  0.0033   9  22.8
1020 BFALLS G   T 1  -5.384  -2.705 F  0.0159  0.2551  10  60.3
1040 HERRING    1   7.368   2.183 L  0.0477  0.1397  23  33.4

-----
1020 BFALLS G   Area 1 Ktchkn Zone 1 Ketchikan    7.200 kV V Gen
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0100 7.2720 kV -34.394     0.0     0.0  5.40000  2.95965

Gen MVar Max:  6.3 Min: -6.25 Contrld bus: 1020 BFALLS G Volt: 1.0100

Line flows to   C   MW       MVar T  MW/MVar Loss  Norm %Norm %Emrg %Rate3
1010 BFALLS    1   5.400   2.960 F  0.0159  0.2551  10  61.6

-----
1040 HERRING    Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0024 34.584 kV -7.357     0.0     0.0

Line flows to   C   MW       MVar T  MW/MVar Loss  Norm %Norm %Emrg %Rate3
1010 BFALLS    1   -7.320  -2.043 L  0.0477  0.1397  23  33.0
1041 HERRING    T 1  -0.000   0.000 F  0.0000  0.0000
1050 MT POINT   1   7.320   2.043 L  0.0134  0.0394  23  33.0

-----
1041 HERRING    Area 1 Ktchkn Zone 1 Ketchikan    0.480 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0024 0.4812 kV -37.357     0.0     0.0

Line flows to   C   MW       MVar T  MW/MVar Loss  Norm %Norm %Emrg %Rate3
1040 HERRING   1   0.000   0.000 F  0.0000  0.0000

-----
1070 KETCH      Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage        Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9881 34.090 kV -8.662     0.0     0.0

Line flows to   C   MW       MVar T  MW/MVar Loss  Norm %Norm %Emrg %Rate3
1060 MT POINT   1   -5.268  -1.203 L  0.0170  0.0505  23  23.5
1100 KETCH T2   T 1  4.237   -0.443 F  0.0063  0.1074  12  35.5
1120 PORTWEST   1   1.031   1.645 L  0.0037  0.0041   6  32.4

```

Exhibit C3

```

-----
1110 KETCH G      Area 1 Ktchkn Zone 1 Ketchikan    4.160 kV V Gen
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0100 4.2016 kv -67.376      0.0      0.0   4.20000 3.67483

Gen MVAr Max: 5.3 Min: -5.25 Contrl d bus: 1110 KETCH G Volt: 1.0100

Line flows to      C   MW      MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1100 KETCH T2     1   4.200   3.675 F   0.0306  0.3637   24   23.3

-----
1100 KETCH T2      Area 1 Ktchkn Zone 1 Ketchikan    12.47 kV Load
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0143 12.648 kv -40.106      8.40000 2.76100

Line flows to      C   MW      MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1070 KETCH        1   -4.231   0.550 F   0.0063  0.1074   12   35.6
1110 KETCH G      T 1   -4.169   -3.311 F   0.0306  0.3637   24   22.2

-----
1210 LPK           Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9671 33.364 kv -9.202      0.0      0.0

Line flows to      C   MW      MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1200 WRDCOVE      1   -4.405   -1.843 L   0.0100  0.0141   12   39.8
1211 LPK GEN       1   0.000    0.000 F   0.0000  0.0000   10   0.0
1220 LPK GEN       1   4.405    1.843 L   0.0251  0.0341   12   39.8

-----
1211 LPK GEN       Area 1 Ktchkn Zone 1 Ketchikan    13.80 kV Load
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9671 13.346 kv 20.798      0.0      0.0

Line flows to      C   MW      MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1210 LPK          T 1   0.000    0.000 F   0.0000  0.0000   10   0.0

-----
1220 LPK GEN       Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9597 33.110 kv -9.466      0.0      0.0

Line flows to      C   MW      MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1210 LPK          1   -4.380   -1.809 L   0.0251  0.0341   12   39.5
1230 N POINT      1   4.380    1.809 L   0.0512  0.0546    9   52.7

-----
1050 MT POINT     Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9993 34.477 kv -7.616      0.0      0.0

Line flows to      C   MW      MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1040 HERRING      1   -7.307   -2.004 L   0.0134  0.0394   23   32.9
1051 MT POINT     T 1   2.002    0.691 V   0.0021  0.0336   10   21.2
1060 MT POINT     1   5.304    1.313 L   0.0197  0.0601   23   23.8

-----
1051 MT POINT     Area 1 Ktchkn Zone 1 Ketchikan    12.47 kV Load
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0058 12.542 kv -38.462      2.00000 0.65700

Line flows to      C   MW      MVAr T   MW/MVar Loss   Norm %Norm %Emrg %Rate3
1050 MT POINT     1   -2.000   -0.657 V   0.0021  0.0336   10   21.1

```

Exhibit C3

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-----
1060 MT POINT      Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9932 34.267 kV -8.182     0.0     0.0

Line flows to      C   MW       MVar T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1050 MT POINT    1   -5.285   -1.253 L  0.0197  0.0601   23  23.6
1070 KETCH       1   5.285    1.253 L  0.0170  0.0505   23  23.6

-----
1230 N POINT      Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9459* 32.635 kV -9.845     0.0     0.0

Line flows to      C   MW       MVar T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1220 LPK GEN     1   -4.329   -1.754 L  0.0512  0.0546   9   51.9
1231 N POINT     T 1  4.329    1.754 V  0.0285  0.3413   5   93.4

-----
1231 N POINT      Area 1 Ktchkn Zone 1 Ketchikan    12.47 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0084 12.575 kV -43.717    4.30000 1.41300

Line flows to      C   MW       MVar T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1230 N POINT     1   -4.300   -1.413 V  0.0285  0.3413   5   90.5

-----
1120 PORTWEST     Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
0.9854 33.995 kV -8.632     0.0     0.0

Line flows to      C   MW       MVar T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1070 KETCH       1   -1.027   -1.641 L  0.0037  0.0041   6   32.3
1121 PORTWEST    T 1  4.323    1.692 V  0.0233  0.2788   5   92.9
1130 BETHE        1   -3.296   -0.051 L  0.0009  0.0026   23  14.3

-----
1121 PORTWEST     Area 1 Ktchkn Zone 1 Ketchikan    12.47 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0027 12.504 kV -41.813    4.30000 1.41300

Line flows to      C   MW       MVar T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
1120 PORTWEST    1   -4.300   -1.413 V  0.0233  0.2788   5   90.5

-----
200 SILVIS        Area 1 Ktchkn Zone 1 Ketchikan    4.160 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0097 4.2005 kV -33.628     0.0     0.0

Line flows to      C   MW       MVar T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
100 SILVIS G     1   -1.999   0.422 L  0.0008  0.0010   2   102.2*
1000 SILVIS      1   1.999   -0.422 F  0.0121  0.0966   2   102.2*

-----
1000 SILVIS        Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load
Voltage           Angle [----LOAD---][--GENERATION--][---SHUNTS---]
1.0149 35.013 kV -6.335     0.0     0.0

Line flows to      C   MW       MVar T  MW/MVar Loss   Norm %Norm %Emrg %Rate3
200 SILVIS        T 1  -1.987   0.518 F  0.0121  0.0966   2   102.7*
1010 BFALLS       1   1.987   -0.518 L  0.0036  0.0033   9   22.8

```

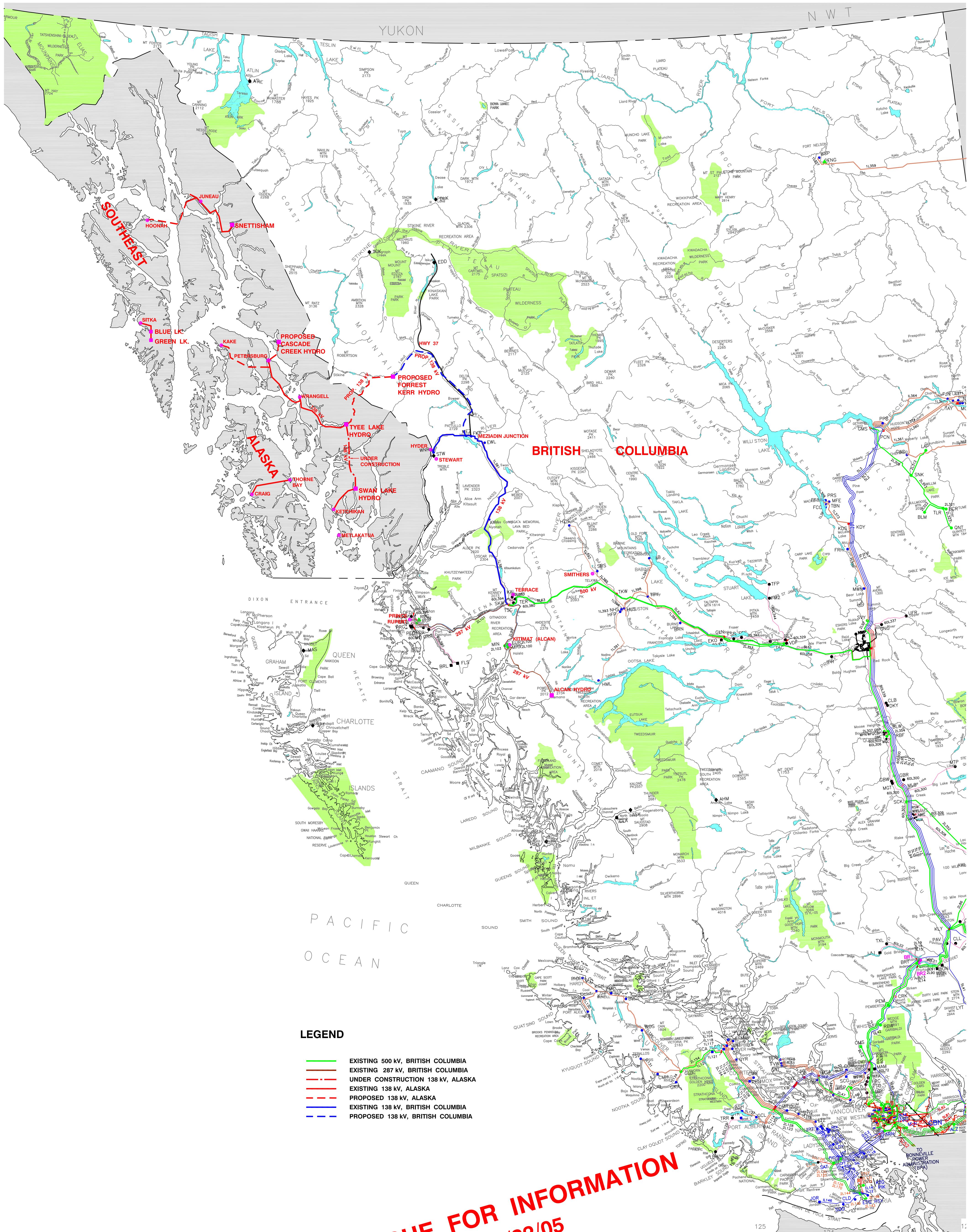
Exhibit C3

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-----  
100 SILVIS G      Area 1 Ktchkn Zone 1 Ketchikan    4.160 kV V Gen  
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]  
1.0100 4.2016 kV -33.597      0.0      0.0   2.00000 -0.4207  
  
Gen MVAr Max: 2.5 Min: -2.50 Contrlrd bus: 100 SILVIS G Volt: 1.0100  
  
Line flows to      C     MW      MVAr T  MW/MVar Loss  Norm %Norm %Emrg %Rate3  
200 SILVIS        1     2.000   -0.421 L  0.0008  0.0010    2 102.2*  
  
-----  
1200 WRDCOVE      Area 1 Ktchkn Zone 1 Ketchikan    34.50 kV Load  
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]  
0.9700 33.467 kV -9.092      0.0      0.0  
  
Line flows to      C     MW      MVAr T  MW/MVar Loss  Norm %Norm %Emrg %Rate3  
1140 BAILEY       1    -7.023   -2.804 L  0.0990  0.1404    12 63.0  
1201 WRDCOVE       T 1    2.608    0.947 V  0.0077  0.0917     5 55.5  
1210 LPK           1    4.415    1.857 L  0.0100  0.0141    12 39.9  
  
-----  
1201 WRDCOVE      Area 1 Ktchkn Zone 1 Ketchikan    12.47 kV Load  
Voltage          Angle [----LOAD---][--GENERATION--][---SHUNTS---]  
0.9989 12.457 kV -40.842    2.60000  0.85500  
  
Line flows to      C     MW      MVAr T  MW/MVar Loss  Norm %Norm %Emrg %Rate3  
1200 WRDCOVE       1    -2.600   -0.855 V  0.0077  0.0917     5 54.7
```

APPENDIX B

BC Hydro Transmission System Map

**SCALE : 1" = 30 MILES
(FOR 24 X 36 SHET ONLY)**



ISSUE FOR INFORMATION
3|22|05

SOUTHEAST ALASKA AND B.C.T.C. TRANSMISSION LINES



APPENDIX C

Plan – Profile Sheets for Kake – Petersburg Intertie

APPENDIX D

Comments on Construction Cost from Doug Trapp

TRAPPER CONSULTING

**315 Rebel Ridge Dr.
Hempill, TX 75948
Phone: (409)787-2866
Fax: (409)787-1538**

March 14, 2005

Commonwealth Associates Inc.
P.O. Box 247
LaConner, Wa. 98257-0247

ATTN: Thomas Small P.E.

SUBJECT: Kake-Petersburg 69KV Construction Estimate

Gentlemen:

As per your request, we offer the following construction cost estimate, along with our assumptions and conclusions for the Kake-Petersburg 69KV transmission line. We used the structure quantities and framing provided by CAI for route "C", the center-south alternative, to fabricate a theoretical design for estimating purposes. All cost is in 2005 dollars, and are based on the current IBEW/NECA outside construction agreement.

Our estimate is limited to the 753 pole power line. We dust defer to the CAI estimates for the marine crossings, survey, design, 69KV tie switch, Kake substation, road construction and clearing. We Believe the information used by CAI to generate these estimates is probably more accurate than what we could offer.

Our estimate for the power line portion of the Petersburg-Kake center-south alternative route is \$16,430,000.00. This translates to \$328,600.00 per mile or \$21,819.00 per pole for the 50 miles of power line proposed.

The following major cost items were included in the above estimate:

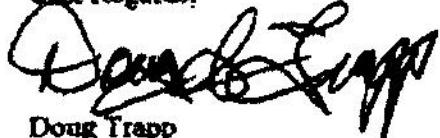
1. Mobilization/Demobilization
2. Bond and Insurance
3. Camp cost / food and lodging
4. Labor cost
5. Supervision
6. Material and Freight
7. Rockdrills and blasting materials
8. Equipment and tools
9. Fuel and maintenance with mechanic
10. Barge / landing craft (occasional use)
11. Air taxi / Alaska Air
12. Helicopter (occasional use)
13. Contingency

Our estimate assumes that roads will be built into the roadless areas, minimizing extensive helicopter construction requirements.

Our material cost estimate assumes 138KV polymer insulators, poles sized by CAI, 336ACSR with standard guying and anchoring. We have allowed for shot rock backfill for the poles and "slug" anchors and culvert foundations for muskeg poles.

If you have questions or wish to discuss this estimate further, please contact me at your convenience.

Best Regards,

A handwritten signature in black ink, appearing to read "Doug Trapp".

Doug Trapp

APPENDIX E

Selected Photographs



Photo E-1 – IPEC diesel powerhouse in Kake and local primary distribution system.



Photo E-2 – Transformers and primary distribution system at powerhouse in Kake.



Photo E-3 – Aerial view of Kake and airport runway looking west.



Photo E-4 – USFS road on Kupreanof Island between nodes T11 and T14.



Photo E-5 – USFS road near node T11 west of Duncan Canal.



Photo B-6 – Intersection of USFS roads 6030 and 6040 on Kupreanof Island at node S5 near Kake.



Photo E-7 – USFS road near Kake.



Photo E-8 – Helicopter landing on USFS road 6031 between nodes S3 and S4 to evaluate depth of muskeg.



Photo E-9 – Lake Tyee transmission line substation near Petersburg.



Photo E-10 – Aerial view of Wrangell Narrows looking south from above Petersburg.



Photo E-11 – View across Wrangell Narrows looking west toward Tonka log handling facility.



Photo E-12 – Wrangell Narrows beach looking east toward Experimental Fur Farm site.



Photo E-13 – Access road to Experimental Fur Farm area looking west from Mitkof Highway toward Wrangell Narrows.



Photo E-14 – Mitkof Highway south of Petersburg with 138-kV Tyee transmission line to the left.



Photo E-15 – View across Wrangell Narrows to Woewodski Island in foreground with entrance to Duncan Canal in the background as seen from USFS road on south end of Mitkof Island.



Photo E-16 – West side of Duncan Canal near node T7 and the location of proposed submarine cable crossing for the Center-South route.



Photo E-17 – View northwest across Duncan Canal from near nodes T5 and T10. This is approximate proposed location of submarine cable crossing of Duncan Canal for the Center-Center route. Petersburg Creek – Duncan Salt Chuck Wilderness Area extends to the right (north) in this photo.



Photo E-18 – View north along east side of Duncan Canal. Node T10 is in center of photo. USFS road 6350 is visible in lower right corner of the photo.



Photo E-19 – Kupreanof Island to the right at Frederick Sound looking directly south towards Petersburg in the distance. Proposed location of the Northern Alternative overhead line along this coastline.



Photo E-20 – Aerial view of Petersburg looking southwest over Wrangell Narrows.

APPENDIX F

IPEC – Kake Service Area Historical Operating Statistics

TABLE F-1
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Historical Customers, Energy Sales and Unit Revenues

	Historical				
	2000	2001	2002	2003	2004
Number of Customers					
Residential	287	285	280	277	268
Commercial	57	56	49	50	45
Large Commercial	9	9	9	8	7
Interruptible	1	1	2	3	2
Public Streetlights	1	1	1	-	-
Small Community Facility	3	3	3	3	3
Large Community Facility	8	8	8	8	8
Total Customers	366	363	352	349	333
Increase (Decrease) over Previous Year		-0.8%	-3.0%	-0.9%	-4.6%
Energy Sales (kWh)					
Residential	1,599,883	1,588,409	1,498,186	1,486,738	1,372,708
Commercial	367,886	370,880	344,062	369,027	305,279
Large Commercial	555,819	559,629	542,045	270,495	229,228
Interruptible	697,469	934,431	1,369,716	1,443,780	474,447
Public Streetlights	8,760	8,760	8,760	8,760	8,760
Small Community Facility	41,522	40,273	33,888	37,160	31,397
Large Community Facility	334,075	293,635	167,059	97,916	104,106
Total Energy Sales	3,605,414	3,796,017	3,963,716	3,713,876	2,525,925
Increase (Decrease) over Previous Year		5.3%	4.4%	-6.3%	-32.0%
Average Usage per Customer (kWh/month)					
Residential	465	464	446	447	427
Commercial	538	552	585	615	565
Large Commercial	5,146	5,182	5,019	2,818	2,729
Interruptible	58,122	77,869	57,072	40,105	19,769
Public Streetlights	730	730	730	-	-
Small Community Facility	1,153	1,119	941	1,032	872
Large Community Facility	3,480	3,059	1,740	1,020	1,084
Annual Change in Usage/Customer					
Residential		0.0%	-4.0%	0.3%	-4.6%
Commercial		2.6%	6.0%	5.1%	-8.1%
Large Commercial		0.7%	-3.1%	-43.9%	-3.1%
Interruptible		34.0%	-26.7%	-29.7%	-50.7%
Public Streetlights					
Small Community Facility		-3.0%	-15.9%	9.7%	-15.5%
Large Community Facility		-12.1%	-43.1%	-41.4%	6.3%
Unit Revenue (cents/kWh)					
Residential (before PCE subsidy)	36.3	37.1	35.5	37.0	38.7
Commercial	36.1	36.7	34.9	36.2	38.2
Large Commercial	35.9	36.6	34.4	37.6	39.0
Interruptible	17.3	17.5	16.0	17.9	20.9
Public Streetlights	54.8	54.8	54.8	54.8	54.8
Small Community Facility	33.9	34.9	33.5	34.8	36.9
Large Community Facility	35.2	37.0	36.6	41.4	42.7
Total Unit Revenues	32.5	32.2	28.6	29.7	35.5

APPENDIX G

Detailed Analytical Tables Power Supply and Economic Analysis

TABLE G-1
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Requirements and Cost of Diesel Production

	BASE CASE									
	Historical			Projected						
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Energy Sales (MWh)										
Residential	1,498	1,487	1,373	1,402	1,432	1,462	1,492	1,524	1,555	1,587
Commercial	886	640	535	537	540	543	545	548	551	554
Interruptyble ¹	1,370	1,444	474	479	484	489	494	499	504	509
Public Facilities	210	144	144	140	144	148	151	153	156	159
Other	-	-	-	-	-	-	-	-	-	-
Total Sales	3,964	3,714	2,526	2,558	2,599	2,641	2,682	2,724	2,766	2,809
Increase % ²	4.4%	-6.3%	-32.0%	1.3%	1.6%	1.6%	1.6%	1.6%	1.5%	1.6%
Station Service/Own Use	62	82	69	37	38	38	39	39	40	41
Street Lights	80	80	80	80	80	80	80	80	80	80
Losses	185	200	202	202	205	208	212	215	218	221
Total Generation (MWh)	4,291	4,076	2,877	2,877	2,922	2,967	3,013	3,058	3,104	3,151
Loss % of Gen. ³	4.3%	4.9%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	1,016	969	684	684	695	706	717	727	738	749
Loadfactor ⁴	48.2%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	313	300	210	210	213	216	220	223	226	230
Fuel Efficiency (kWh/gallon)	13.7	13.6	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 0.90	\$ 1.12	\$ 1.49	\$ 1.80	\$ 1.62	\$ 1.67	\$ 1.72	\$ 1.77	\$ 1.82	\$ 1.88
Power Production Cost (\$000)										
Fuel	282	\$ 335	\$ 313	\$ 377	\$ 345	\$ 361	\$ 377	\$ 394	\$ 412	\$ 431
Variable O&M				86	90	94	97	101	105	110
Renewals & Replacements				-	-	-	-	-	-	-
Total Production Cost				\$ 463	\$ 435	\$ 455	\$ 474	\$ 495	\$ 517	\$ 541
Unit Cost (c/kWh)				16.1	14.9	15.3	15.7	16.2	16.7	17.2

TABLE G-1
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Requirements and Cost of Diesel Production

	BASE CASE									
	Projected									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Energy Sales (MWh)										
Residential	1,620	1,653	1,686	1,720	1,755	1,790	1,825	1,861	1,898	1,935
Commercial	556	559	562	565	568	570	573	576	579	582
Interruptyble ¹	514	519	524	529	535	540	545	551	556	562
Public Facilities	162	165	168	172	175	178	181	185	188	191
Other	-	-	-	-	-	-	-	-	-	-
Total Sales	2,852	2,896	2,941	2,986	3,031	3,078	3,125	3,173	3,221	3,270
Increase % ²	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Station Service/Own Use	41	42	42	43	44	44	45	46	46	47
Street Lights	80	80	80	80	80	80	80	80	80	80
Losses	225	228	231	235	238	242	246	249	253	257
Total Generation (MWh)	3,198	3,246	3,294	3,344	3,393	3,444	3,496	3,548	3,600	3,654
Loss % of Gen. ³	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	761	772	783	795	807	819	831	844	856	869
Loadfactor ⁴	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	233	237	240	244	247	251	255	259	262	266
Fuel Efficiency (kWh/gallon)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 1.93	\$ 1.99	\$ 2.05	\$ 2.11	\$ 2.18	\$ 2.24	\$ 2.31	\$ 2.38	\$ 2.45	\$ 2.52
Power Production Cost (\$000)										
Fuel	\$ 451	\$ 471	\$ 493	\$ 515	\$ 538	\$ 563	\$ 588	\$ 615	\$ 643	\$ 672
Variable O&M	114	119	123	128	134	139	145	150	156	163
Renewals & Replacements	-	-	-	35	35	35	35	35	70	70
Total Production Cost	\$ 565	\$ 590	\$ 616	\$ 678	\$ 707	\$ 737	\$ 768	\$ 800	\$ 869	\$ 905
Unit Cost (c/kWh)	17.7	18.2	18.7	20.3	20.8	21.4	22.0	22.5	24.1	24.8

TABLE G-1
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Requirements and Cost of Diesel Production

	BASE CASE						
	Projected						
	2022	2023	2024	2025	2026	2027	2028
Energy Sales (MWh)							
Residential	1,973	2,011	2,050	2,089	2,129	2,170	2,211
Commercial	585	588	591	594	597	600	603
Interruption ¹	568	573	579	585	591	597	602
Public Facilities	195	198	202	206	209	213	217
Other	-	-	-	-	-	-	-
Total Sales	3,320	3,370	3,421	3,473	3,526	3,579	3,633
Increase % ²	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Station Service/Own Use	48	49	49	50	51	52	52
Street Lights	80	80	80	80	80	80	80
Losses	260	264	268	272	276	280	284
Total Generation (MWh)	3,708	3,763	3,818	3,875	3,933	3,991	4,049
Loss % of Gen. ³	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	882	895	908	922	935	949	963
Loadfactor ⁴	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	270	274	278	282	287	291	295
Fuel Efficiency (kWh/gallon)	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 2.60	\$ 2.68	\$ 2.76	\$ 2.84	\$ 2.93	\$ 3.01	\$ 3.10
Power Production Cost (\$000)							
Fuel	\$ 702	\$ 734	\$ 767	\$ 802	\$ 838	\$ 876	\$ 916
Variable O&M	169	176	183	190	198	206	214
Renewals & Replacements	70	70	70	70	70	70	70
Total Production Cost	\$ 941	\$ 980	\$ 1,020	\$ 1,062	\$ 1,106	\$ 1,152	\$ 1,200
Unit Cost (c/kWh)	25.4	26.0	26.7	27.4	28.1	28.9	29.6

TABLE G-2
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Annual Costs and Estimated Savings with KPTL

BASE CASE

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Energy Requirements (MWh) ¹	3,058	3,104	3,151	3,198	3,246	3,294	3,344	3,393	3,444	3,496
Energy Purchased (MWh) ²	3,119	3,166	3,214	3,262	3,311	3,359	3,410	3,461	3,513	3,566
Purchased Power Price (¢/kWh) ³	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Annual Costs with KPTL (\$000)										
Purchased Power ⁴	\$ 208	\$ 211	\$ 214	\$ 217	\$ 221	\$ 224	\$ 227	\$ 231	\$ 234	\$ 238
KPTL O&M ⁵	171	175	180	184	189	231	237	243	249	255
KPTL A&G ⁶	50	51	53	54	55	57	58	60	61	63
KPTL R&R ⁷	46	46	46	46	46	46	46	46	46	46
Total Annual Costs with KPTL	\$ 475	\$ 483	\$ 493	\$ 501	\$ 511	\$ 558	\$ 568	\$ 580	\$ 590	\$ 602
Unit Cost (¢/kWh) ⁸	15.5	15.6	15.6	15.7	15.7	16.9	17.0	17.1	17.1	17.2
Savings with KPTL (\$000) ⁹	\$ 21	\$ 35	\$ 49	\$ 65	\$ 80	\$ 58	\$ 111	\$ 128	\$ 148	\$ 167
Savings (¢/kWh) ¹⁰	0.7	1.1	1.6	2.0	2.5	1.8	3.3	3.8	4.3	4.8
Breakeven Cost of Power (¢/kWh) ¹¹	7.3	7.8	8.2	8.6	9.1	8.4	9.9	10.4	10.9	11.4
NPV Savings (2009-2028) (\$000)	\$ 1,257									
Discount Rate	6.0%									

TABLE G-2
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Annual Costs and Estimated Savings with KPTL

BASE CASE

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Energy Requirements (MWh) ¹	3,548	3,600	3,654	3,708	3,763	3,818	3,875	3,933	3,991	4,049
Energy Purchased (MWh) ²	3,619	3,672	3,727	3,782	3,838	3,895	3,953	4,011	4,071	4,130
Purchased Power Price (¢/kWh) ³	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Annual Costs with KPTL (\$000)										
Purchased Power ⁴	\$ 241	\$ 245	\$ 248	\$ 252	\$ 256	\$ 260	\$ 264	\$ 267	\$ 271	\$ 275
KPTL O&M ⁵	311	319	327	335	343	400	410	420	430	441
KPTL A&G ⁶	64	66	68	69	71	73	75	76	78	80
KPTL R&R ⁷	46	46	46	46	46	46	46	46	46	46
Total Annual Costs with KPTL	\$ 662	\$ 676	\$ 689	\$ 702	\$ 716	\$ 779	\$ 795	\$ 809	\$ 825	\$ 842
Unit Cost (¢/kWh) ⁸	18.7	18.8	18.9	18.9	19.0	20.4	20.5	20.6	20.7	20.8
Savings with KPTL (\$000) ⁹	\$ 139	\$ 194	\$ 217	\$ 241	\$ 266	\$ 243	\$ 268	\$ 299	\$ 329	\$ 359
Savings (¢/kWh) ¹⁰	3.9	5.4	5.9	6.5	7.1	6.4	6.9	7.6	8.2	8.9
Breakeven Cost of Power (¢/kWh) ¹¹	10.5	11.9	12.5	13.0	13.6	12.9	13.5	14.1	14.7	15.3
NPV Savings (2009-2028) (\$000)										
Discount Rate										

TABLE G-3
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Requirements and Cost of Diesel Production

HIGH FUEL PRICE CASE

	Historical			Projected						
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Energy Sales (MWh)										
Residential	1,498	1,487	1,373	1,402	1,432	1,462	1,492	1,524	1,555	1,587
Commercial	886	640	535	537	540	543	545	548	551	554
Interruptyble ¹	1,370	1,444	474	479	484	489	494	499	504	509
Public Facilities	210	144	144	140	144	148	151	153	156	159
Other	-	-	-	-	-	-	-	-	-	-
Total Sales	3,964	3,714	2,526	2,558	2,599	2,641	2,682	2,724	2,766	2,809
Increase % ²	4.4%	-6.3%	-32.0%	1.3%	1.6%	1.6%	1.6%	1.6%	1.5%	1.6%
Station Service/Own Use	62	82	69	37	38	38	39	39	40	41
Street Lights	80	80	80	80	80	80	80	80	80	80
Losses	185	200	202	202	205	208	212	215	218	221
Total Generation (MWh)	4,291	4,076	2,877	2,877	2,922	2,967	3,013	3,058	3,104	3,151
Loss % of Gen. ³	4.3%	4.9%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	1,016	969	684	684	695	706	717	727	738	749
Loadfactor ⁴	48.2%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	313	300	210	210	213	216	220	223	226	230
Fuel Efficiency (kWh/gallon)	13.7	13.6	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 0.90	\$ 1.12	\$ 1.49	\$ 2.00	\$ 2.08	\$ 2.16	\$ 2.25	\$ 2.34	\$ 2.43	\$ 2.53
Power Production Cost (\$000)										
Fuel	282	\$ 335	\$ 313	\$ 419	\$ 443	\$ 468	\$ 494	\$ 521	\$ 550	\$ 581
Variable O&M				86	90	94	97	101	105	110
Renewals & Replacements				-	-	-	-	-	-	-
Total Production Cost				\$ 505	\$ 533	\$ 562	\$ 591	\$ 622	\$ 655	\$ 691
Unit Cost (c/kWh)				17.6	18.2	18.9	19.6	20.4	21.1	21.9

TABLE G-3
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Requirements and Cost of Diesel Production

HIGH FUEL PRICE CASE

	Projected									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Energy Sales (MWh)										
Residential	1,620	1,653	1,686	1,720	1,755	1,790	1,825	1,861	1,898	1,935
Commercial	556	559	562	565	568	570	573	576	579	582
Interruptyble ¹	514	519	524	529	535	540	545	551	556	562
Public Facilities	162	165	168	172	175	178	181	185	188	191
Other	-	-	-	-	-	-	-	-	-	-
Total Sales	2,852	2,896	2,941	2,986	3,031	3,078	3,125	3,173	3,221	3,270
Increase % ²	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Station Service/Own Use	41	42	42	43	44	44	45	46	46	47
Street Lights	80	80	80	80	80	80	80	80	80	80
Losses	225	228	231	235	238	242	246	249	253	257
Total Generation (MWh)	3,198	3,246	3,294	3,344	3,393	3,444	3,496	3,548	3,600	3,654
Loss % of Gen. ³	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	761	772	783	795	807	819	831	844	856	869
Loadfactor ⁴	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	233	237	240	244	247	251	255	259	262	266
Fuel Efficiency (kWh/gallon)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 2.63	\$ 2.74	\$ 2.85	\$ 2.96	\$ 3.08	\$ 3.20	\$ 3.33	\$ 3.46	\$ 3.60	\$ 3.75
Power Production Cost (\$000)										
Fuel	\$ 613	\$ 647	\$ 683	\$ 721	\$ 761	\$ 804	\$ 848	\$ 895	\$ 945	\$ 997
Variable O&M	114	119	123	128	134	139	145	150	156	163
Renewals & Replacements	-	-	-	35	35	35	35	35	70	70
Total Production Cost	\$ 727	\$ 766	\$ 806	\$ 884	\$ 930	\$ 977	\$ 1,028	\$ 1,080	\$ 1,171	\$ 1,230
Unit Cost (c/kWh)	22.7	23.6	24.5	26.4	27.4	28.4	29.4	30.4	32.5	33.7

TABLE G-3
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Requirements and Cost of Diesel Production

HIGH FUEL PRICE CASE

	Projected						
	2022	2023	2024	2025	2026	2027	2028
Energy Sales (MWh)							
Residential	1,973	2,011	2,050	2,089	2,129	2,170	2,211
Commercial	585	588	591	594	597	600	603
Interruptible ¹	568	573	579	585	591	597	602
Public Facilities	195	198	202	206	209	213	217
Other	-	-	-	-	-	-	-
Total Sales	3,320	3,370	3,421	3,473	3,526	3,579	3,633
Increase % ²	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Station Service/Own Use	48	49	49	50	51	52	52
Street Lights	80	80	80	80	80	80	80
Losses	260	264	268	272	276	280	284
Total Generation (MWh)	3,708	3,763	3,818	3,875	3,933	3,991	4,049
Loss % of Gen. ³	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	882	895	908	922	935	949	963
Loadfactor ⁴	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	270	274	278	282	287	291	295
Fuel Efficiency (kWh/gallon)	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 3.90	\$ 4.05	\$ 4.21	\$ 4.38	\$ 4.56	\$ 4.74	\$ 4.93
Power Production Cost (\$000)							
Fuel	\$ 1,053	\$ 1,111	\$ 1,172	\$ 1,237	\$ 1,306	\$ 1,378	\$ 1,454
Variable O&M	169	176	183	190	198	206	214
Renewals & Replacements	70	70	70	70	70	70	70
Total Production Cost	\$ 1,291	\$ 1,357	\$ 1,425	\$ 1,497	\$ 1,574	\$ 1,654	\$ 1,738
Unit Cost (c/kWh)	34.8	36.1	37.3	38.6	40.0	41.4	42.9

TABLE G-4
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Annual Costs and Estimated Savings with KPTL

HIGH FUEL PRICE CASE

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Energy Requirements (MWh) ¹	3,058	3,104	3,151	3,198	3,246	3,294	3,344	3,393	3,444	3,496
Energy Purchased (MWh) ²	3,119	3,166	3,214	3,262	3,311	3,359	3,410	3,461	3,513	3,566
Purchased Power Price (¢/kWh) ³	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Annual Costs with KPTL (\$000)										
Purchased Power ⁴	\$ 208	\$ 211	\$ 214	\$ 217	\$ 221	\$ 224	\$ 227	\$ 231	\$ 234	\$ 238
KPTL O&M ⁵	171	175	180	184	189	231	237	243	249	255
KPTL A&G ⁶	50	51	53	54	55	57	58	60	61	63
KPTL R&R ⁷	46	46	46	46	46	46	46	46	46	46
Total Annual Costs with KPTL	\$ 475	\$ 483	\$ 493	\$ 501	\$ 511	\$ 558	\$ 568	\$ 580	\$ 590	\$ 602
Unit Cost (¢/kWh) ⁸	15.5	15.6	15.6	15.7	15.7	16.9	17.0	17.1	17.1	17.2
Savings with KPTL (\$000) ⁹	\$ 148	\$ 173	\$ 199	\$ 227	\$ 256	\$ 249	\$ 318	\$ 352	\$ 389	\$ 428
Savings (¢/kWh) ¹⁰	4.8	5.6	6.3	7.1	7.9	7.6	9.5	10.4	11.3	12.2
Breakeven Cost of Power (¢/kWh) ¹¹	11.4	12.1	12.9	13.6	14.4	14.1	16.0	16.8	17.7	18.7
NPV Savings (2009-2028) (\$000)	\$ 3,565									
Discount Rate	6.0%									

TABLE G-4
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Annual Costs and Estimated Savings with KPTL

HIGH FUEL PRICE CASE

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Energy Requirements (MWh) ¹	3,548	3,600	3,654	3,708	3,763	3,818	3,875	3,933	3,991	4,049
Energy Purchased (MWh) ²	3,619	3,672	3,727	3,782	3,838	3,895	3,953	4,011	4,071	4,130
Purchased Power Price (¢/kWh) ³	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Annual Costs with KPTL (\$000)										
Purchased Power ⁴	\$ 241	\$ 245	\$ 248	\$ 252	\$ 256	\$ 260	\$ 264	\$ 267	\$ 271	\$ 275
KPTL O&M ⁵	311	319	327	335	343	400	410	420	430	441
KPTL A&G ⁶	64	66	68	69	71	73	75	76	78	80
KPTL R&R ⁷	46	46	46	46	46	46	46	46	46	46
Total Annual Costs with KPTL	\$ 662	\$ 676	\$ 689	\$ 702	\$ 716	\$ 779	\$ 795	\$ 809	\$ 825	\$ 842
Unit Cost (¢/kWh) ⁸	18.7	18.8	18.9	18.9	19.0	20.4	20.5	20.6	20.7	20.8
Savings with KPTL (\$000) ⁹	\$ 420	\$ 496	\$ 543	\$ 591	\$ 643	\$ 648	\$ 705	\$ 767	\$ 832	\$ 899
Savings (¢/kWh) ¹⁰	11.8	13.8	14.9	15.9	17.1	17.0	18.2	19.5	20.8	22.2
Breakeven Cost of Power (¢/kWh) ¹¹	18.3	20.2	21.2	22.3	23.4	23.3	24.5	25.8	27.1	28.4
NPV Savings (2009-2028) (\$000)										
Discount Rate										

TABLE G-5
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Energy Requirements and Cost of Diesel Production

HIGH KAKE LOADS CASE

	Historical			Projected					
	2002	2003	2004	2005	2006	2007	2008	2009	2011
Energy Sales (MWh)									
Residential	1,498	1,487	1,373	1,402	1,432	1,462	1,492	1,524	1,570
Commercial	886	640	535	537	540	543	545	863	880
Interruptyble ¹	1,370	1,444	474	479	484	489	494	1,407	1,435
Public Facilities	210	144	144	140	144	148	151	153	156
Other	-	-	-	-	-	-	-	-	-
Total Sales	3,964	3,714	2,526	2,558	2,599	2,641	2,682	3,947	4,042
Increase % ²	4.4%	-6.3%	-32.0%	1.3%	1.6%	1.6%	1.6%	47.2%	2.4%
Station Service/Own Use	62	82	69	37	38	38	39	57	58
Street Lights	80	80	80	80	80	80	80	80	80
Losses	185	200	202	202	205	208	212	308	316
Total Generation (MWh)	4,291	4,076	2,877	2,877	2,922	2,967	3,013	4,392	4,496
Loss % of Gen. ³	4.3%	4.9%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	1,016	969	684	684	695	706	717	1,044	1,069
Loadfactor ⁴	48.2%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	313	300	210	210	213	216	220	320	328
Fuel Efficiency (kWh/gallon)	13.7	13.6	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 0.90	\$ 1.12	\$ 1.49	\$ 1.80	\$ 1.62	\$ 1.67	\$ 1.72	\$ 1.77	\$ 1.82
Power Production Cost (\$000)	282	\$ 335	\$ 313	\$ 377	\$ 345	\$ 361	\$ 377	\$ 566	\$ 597
Fuel				\$ 86	\$ 90	\$ 94	\$ 97	\$ 145	\$ 153
Variable O&M									\$ 160
Renewals & Replacements									
Total Production Cost									
Unit Cost (c/kWh)				\$ 463	\$ 435	\$ 455	\$ 474	\$ 711	\$ 750
				16.1	14.9	15.3	15.7	16.2	16.7
									17.2

TABLE G-5
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Energy Requirements and Cost of Diesel Production

HIGH KAKE LOADS CASE

	Projected									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Energy Sales (MWh)										
Residential	1,668	1,719	1,771	1,825	1,880	1,936	1,994	2,054	2,115	2,178
Commercial	915	934	952	971	991	1,011	1,031	1,051	1,073	1,094
Interruptible ¹	1,493	1,523	1,554	1,585	1,616	1,649	1,682	1,715	1,750	1,785
Public Facilities	162	165	168	172	175	178	181	185	188	191
Other	-	-	-	-	-	-	-	-	-	-
Total Sales	4,239	4,341	4,445	4,552	4,662	4,774	4,888	5,005	5,125	5,248
Increase % ²	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
Station Service/Own Use	61	63	64	66	67	69	71	72	74	76
Street Lights	80	80	80	80	80	80	80	80	80	80
Losses	331	339	347	355	363	372	381	390	399	408
Total Generation (MWh)	4,711	4,823	4,936	5,053	5,172	5,295	5,420	5,547	5,678	5,812
Loss % of Gen. ³	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	1,120	1,147	1,174	1,202	1,230	1,259	1,289	1,319	1,350	1,382
Loadfactor ⁴	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	343	351	360	368	377	386	395	404	414	423
Fuel Efficiency (kWh/gallon)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 1.93	\$ 1.99	\$ 2.05	\$ 2.11	\$ 2.18	\$ 2.24	\$ 2.31	\$ 2.38	\$ 2.45	\$ 2.52
Power Production Cost (\$000)										
Fuel	\$ 664	\$ 700	\$ 738	\$ 778	\$ 820	\$ 865	\$ 912	\$ 962	\$ 1,014	\$ 1,069
Variable O&M	168	176	185	194	204	214	224	235	247	259
Renewals & Replacements	-	-	-	35	35	35	35	35	70	70
Total Production Cost	\$ 832	\$ 876	\$ 923	\$ 1,007	\$ 1,059	\$ 1,114	\$ 1,171	\$ 1,232	\$ 1,331	\$ 1,398
Unit Cost (c/kWh)	17.7	18.2	18.7	19.9	20.5	21.0	21.6	22.2	23.4	24.0

TABLE G-5
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Energy Requirements and Cost of Diesel Production

HIGH KAKE LOADS CASE

	Projected						
	2022	2023	2024	2025	2026	2027	2028
Energy Sales (MWh)							
Residential	2,242	2,309	2,376	2,446	2,518	2,591	2,666
Commercial	1,116	1,138	1,161	1,184	1,208	1,232	1,257
Interruptible ¹	1,820	1,857	1,894	1,932	1,970	2,010	2,050
Public Facilities	195	198	202	206	209	213	217
Other	-	-	-	-	-	-	-
Total Sales	5,373	5,502	5,633	5,767	5,905	6,046	6,190
Increase % ²	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
Station Service/Own Use	78	79	81	83	85	87	89
Street Lights	80	80	80	80	80	80	80
Losses	418	428	438	448	459	469	480
Total Generation (MWh)	5,949	6,089	6,232	6,378	6,529	6,682	6,839
Loss % of Gen. ³	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	1,415	1,448	1,482	1,517	1,553	1,589	1,626
Loadfactor ⁴	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	434	444	454	465	476	487	498
Fuel Efficiency (kWh/gallon)	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 2.60	\$ 2.68	\$ 2.76	\$ 2.84	\$ 2.93	\$ 3.01	\$ 3.10
Power Production Cost (\$000)							
Fuel	\$ 1,127	\$ 1,188	\$ 1,252	\$ 1,320	\$ 1,392	\$ 1,467	\$ 1,547
Variable O&M	272	285	299	314	329	345	362
Renewals & Replacements	70	70	70	70	70	70	70
Total Production Cost	\$ 1,469	\$ 1,543	\$ 1,621	\$ 1,704	\$ 1,791	\$ 1,882	\$ 1,979
Unit Cost (c/kWh)	24.7	25.3	26.0	26.7	27.4	28.2	28.9

TABLE G-6
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Annual Costs and Estimated Savings with KPTL

HIGH KAKE LOADS CASE

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Energy Requirements (MWh) ¹	4,392	4,496	4,602	4,711	4,823	4,936	5,053	5,172	5,295	5,420
Energy Purchased (MWh) ²	4,479	4,585	4,694	4,805	4,919	5,035	5,154	5,275	5,400	5,528
Purchased Power Price (¢/kWh) ³	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Annual Costs with KPTL (\$000)										
Purchased Power ⁴	\$ 299	\$ 306	\$ 313	\$ 320	\$ 328	\$ 336	\$ 344	\$ 352	\$ 360	\$ 369
KPTL O&M ⁵	171	175	180	184	189	231	237	243	249	255
KPTL A&G ⁶	50	51	53	54	55	57	58	60	61	63
KPTL R&R ⁷	46	46	46	46	46	46	46	46	46	46
Total Annual Costs with KPTL	\$ 566	\$ 578	\$ 592	\$ 604	\$ 618	\$ 670	\$ 685	\$ 701	\$ 716	\$ 733
Unit Cost (¢/kWh) ⁸	12.9	12.9	12.9	12.8	12.8	13.6	13.6	13.6	13.5	13.5
Savings with KPTL (\$000) ⁹	\$ 146	\$ 173	\$ 199	\$ 229	\$ 259	\$ 254	\$ 324	\$ 360	\$ 400	\$ 440
Savings (¢/kWh) ¹⁰	3.3	3.8	4.3	4.9	5.4	5.1	6.4	7.0	7.6	8.1
Breakeven Cost of Power (¢/kWh) ¹¹	9.9	10.4	10.9	11.4	11.9	11.7	13.0	13.5	14.1	14.6
NPV Savings (2009-2028) (\$000)	\$ 3,683									
Discount Rate	6.0%									

TABLE G-6
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Annual Costs and Estimated Savings with KPTL

HIGH KAKE LOADS CASE

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Energy Requirements (MWh) ¹	5,547	5,678	5,812	5,949	6,089	6,232	6,378	6,529	6,682	6,839
Energy Purchased (MWh) ²	5,658	5,792	5,928	6,068	6,210	6,356	6,506	6,659	6,815	6,975
Purchased Power Price (¢/kWh) ³	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Annual Costs with KPTL (\$000)										
Purchased Power ⁴	\$ 377	\$ 386	\$ 395	\$ 405	\$ 414	\$ 424	\$ 434	\$ 444	\$ 454	\$ 465
KPTL O&M ⁵	311	319	327	335	343	400	410	420	430	441
KPTL A&G ⁶	64	66	68	69	71	73	75	76	78	80
KPTL R&R ⁷	46	46	46	46	46	46	46	46	46	46
Total Annual Costs with KPTL	\$ 798	\$ 817	\$ 836	\$ 855	\$ 874	\$ 943	\$ 965	\$ 986	\$ 1,008	\$ 1,032
Unit Cost (¢/kWh) ⁸	14.4	14.4	14.4	14.4	14.4	15.1	15.1	15.1	15.1	15.1
Savings with KPTL (\$000) ⁹	\$ 435	\$ 516	\$ 564	\$ 616	\$ 671	\$ 681	\$ 742	\$ 807	\$ 877	\$ 949
Savings (¢/kWh) ¹⁰	7.8	9.1	9.7	10.4	11.0	10.9	11.6	12.4	13.1	13.9
Breakeven Cost of Power (¢/kWh) ¹¹	14.3	15.6	16.2	16.8	17.5	17.4	18.1	18.8	19.5	20.3
NPV Savings (2009-2028) (\$000)										
Discount Rate										

TABLE G-7
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Energy Requirements and Cost of Diesel Production

	NO LOAD GROWTH CASE									
	Historical			Projected						
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Energy Sales (MWh)										
Residential	1,498	1,487	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373
Commercial	886	640	535	535	535	535	535	535	535	535
Interruptyble ¹	1,370	1,444	474	474	474	474	474	474	474	474
Public Facilities	210	144	144	136	136	136	136	136	136	136
Other	-	-	-	-	-	-	-	-	-	-
Total Sales	3,964	3,714	2,526	2,517	2,517	2,517	2,517	2,517	2,517	2,517
Increase % ²	4.4%	-6.3%	-32.0%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Station Service/Own Use	62	82	69	36	36	36	36	36	36	36
Street Lights	80	80	80	80	80	80	80	80	80	80
Losses	185	200	202	199	199	199	199	199	199	199
Total Generation (MWh)	4,291	4,076	2,877	2,832	2,832	2,832	2,832	2,832	2,832	2,832
Loss % of Gen. ³	4.3%	4.9%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	1,016	969	684	674	674	674	674	674	674	674
Loadfactor ⁴	48.2%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	313	300	210	206	206	206	206	206	206	206
Fuel Efficiency (kWh/gallon)	13.7	13.6	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 0.90	\$ 1.12	\$ 1.49	\$ 1.80	\$ 1.62	\$ 1.67	\$ 1.72	\$ 1.77	\$ 1.82	\$ 1.88
Power Production Cost (\$000)										
Fuel	282	\$ 335	\$ 313	\$ 371	\$ 334	\$ 344	\$ 355	\$ 365	\$ 376	\$ 388
Variable O&M				85	87	89	91	94	96	99
Renewals & Replacements				-	-	-	-	-	-	-
Total Production Cost				\$ 456	\$ 421	\$ 433	\$ 446	\$ 459	\$ 472	\$ 487
Unit Cost (c/kWh)				16.1	14.9	15.3	15.7	16.2	16.7	17.2

TABLE G-7
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Energy Requirements and Cost of Diesel Production

NO LOAD GROWTH CASE

	Projected									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Energy Sales (MWh)										
Residential	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373
Commercial	535	535	535	535	535	535	535	535	535	535
Interruptyble ¹	474	474	474	474	474	474	474	474	474	474
Public Facilities	136	136	136	136	136	136	136	136	136	136
Other	-	-	-	-	-	-	-	-	-	-
Total Sales	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517
Increase % ²	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Station Service/Own Use	36	36	36	36	36	36	36	36	36	36
Street Lights	80	80	80	80	80	80	80	80	80	80
Losses	199	199	199	199	199	199	199	199	199	199
Total Generation (MWh)	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832
Loss % of Gen. ³	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	674	674	674	674	674	674	674	674	674	674
Loadfactor ⁴	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	206	206	206	206	206	206	206	206	206	206
Fuel Efficiency (kWh/gallon)	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 1.93	\$ 1.99	\$ 2.05	\$ 2.11	\$ 2.18	\$ 2.24	\$ 2.31	\$ 2.38	\$ 2.45	\$ 2.52
Power Production Cost (\$000)										
Fuel	\$ 399	\$ 411	\$ 424	\$ 436	\$ 449	\$ 463	\$ 477	\$ 491	\$ 506	\$ 521
Variable O&M	101	104	106	109	111	114	117	120	123	126
Renewals & Replacements	-	-	-	35	35	35	35	35	70	70
Total Production Cost	\$ 500	\$ 515	\$ 530	\$ 580	\$ 595	\$ 612	\$ 629	\$ 646	\$ 698	\$ 717
Unit Cost (c/kWh)	17.7	18.2	18.7	20.5	21.0	21.6	22.2	22.8	24.7	25.3

TABLE G-7
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Energy Sales, Energy Requirements and Cost of Diesel Production

NO LOAD GROWTH CASE

	Projected						
	2022	2023	2024	2025	2026	2027	2028
Energy Sales (MWh)							
Residential	1,373	1,373	1,373	1,373	1,373	1,373	1,373
Commercial	535	535	535	535	535	535	535
Interruption ¹	474	474	474	474	474	474	474
Public Facilities	136	136	136	136	136	136	136
Other	-	-	-	-	-	-	-
Total Sales	2,517	2,517	2,517	2,517	2,517	2,517	2,517
Increase % ²	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Station Service/Own Use	36	36	36	36	36	36	36
Street Lights	80	80	80	80	80	80	80
Losses	199	199	199	199	199	199	199
Total Generation (MWh)	2,832	2,832	2,832	2,832	2,832	2,832	2,832
Loss % of Gen. ³	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Peak Demand (kW)	674	674	674	674	674	674	674
Loadfactor ⁴	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
Fuel Consumption (000gals)	206	206	206	206	206	206	206
Fuel Efficiency (kWh/gallon)	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Cost of Fuel (\$/gallon)	\$ 2.60	\$ 2.68	\$ 2.76	\$ 2.84	\$ 2.93	\$ 3.01	\$ 3.10
Power Production Cost (\$000)							
Fuel	\$ 536	\$ 553	\$ 569	\$ 586	\$ 604	\$ 622	\$ 641
Variable O&M	129	133	136	139	143	146	150
Renewals & Replacements	70	70	70	70	70	70	70
Total Production Cost	\$ 735	\$ 755	\$ 775	\$ 795	\$ 817	\$ 838	\$ 860
Unit Cost (c/kWh)	26.0	26.7	27.4	28.1	28.8	29.6	30.4

TABLE G-8
 Kake - Petersburg Intertie Study
 IPEC - Kake Service Area

Projected Annual Costs and Estimated Savings with KPTL

NO LOAD GROWTH CASE

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Energy Requirements (MWh) ¹	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832
Energy Purchased (MWh) ²	2,889	2,889	2,889	2,889	2,889	2,889	2,889	2,889	2,889	2,889
Purchased Power Price (¢/kWh) ³	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Annual Costs with KPTL (\$000)										
Purchased Power ⁴	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193
KPTL O&M ⁵	171	175	180	184	189	231	237	243	249	255
KPTL A&G ⁶	50	51	53	54	55	57	58	60	61	63
KPTL R&R ⁷	46	46	46	46	46	46	46	46	46	46
Total Annual Costs with KPTL	\$ 460	\$ 465	\$ 472	\$ 477	\$ 483	\$ 527	\$ 534	\$ 542	\$ 549	\$ 557
Unit Cost (¢/kWh) ⁸	16.2	16.4	16.7	16.8	17.1	18.6	18.9	19.1	19.4	19.7
Savings with KPTL (\$000) ⁹	\$ -	\$ 8	\$ 15	\$ 24	\$ 33	\$ 3	\$ 47	\$ 54	\$ 64	\$ 72
Savings (¢/kWh) ¹⁰	-	0.3	0.5	0.8	1.2	0.1	1.7	1.9	2.3	2.5
Breakeven Cost of Power (¢/kWh) ¹¹	6.7	7.0	7.2	7.5	7.8	6.8	8.3	8.5	8.9	9.2
NPV Savings (2009-2028) (\$000)	\$ 420									
Discount Rate	6.0%									

TABLE G-8
Kake - Petersburg Intertie Study
IPEC - Kake Service Area

Projected Annual Costs and Estimated Savings with KPTL

NO LOAD GROWTH CASE

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Energy Requirements (MWh) ¹	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832
Energy Purchased (MWh) ²	2,889	2,889	2,889	2,889	2,889	2,889	2,889	2,889	2,889	2,889
Purchased Power Price (¢/kWh) ³	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Annual Costs with KPTL (\$000)										
Purchased Power ⁴	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193	\$ 193
KPTL O&M ⁵	311	319	327	335	343	400	410	420	430	441
KPTL A&G ⁶	64	66	68	69	71	73	75	76	78	80
KPTL R&R ⁷	46	46	46	46	46	46	46	46	46	46
Total Annual Costs with KPTL	\$ 614	\$ 624	\$ 634	\$ 643	\$ 653	\$ 712	\$ 724	\$ 735	\$ 747	\$ 760
Unit Cost (¢/kWh) ⁸	21.7	22.0	22.4	22.7	23.1	25.1	25.6	26.0	26.4	26.8
Savings with KPTL (\$000) ⁹	\$ 33	\$ 76	\$ 84	\$ 93	\$ 104	\$ 64	\$ 72	\$ 83	\$ 92	\$ 102
Savings (¢/kWh) ¹⁰	1.2	2.7	3.0	3.3	3.7	2.3	2.5	2.9	3.2	3.6
Breakeven Cost of Power (¢/kWh) ¹¹	7.8	9.3	9.6	9.9	10.3	8.9	9.2	9.5	9.9	10.2
NPV Savings (2009-2028) (\$000)										
Discount Rate										